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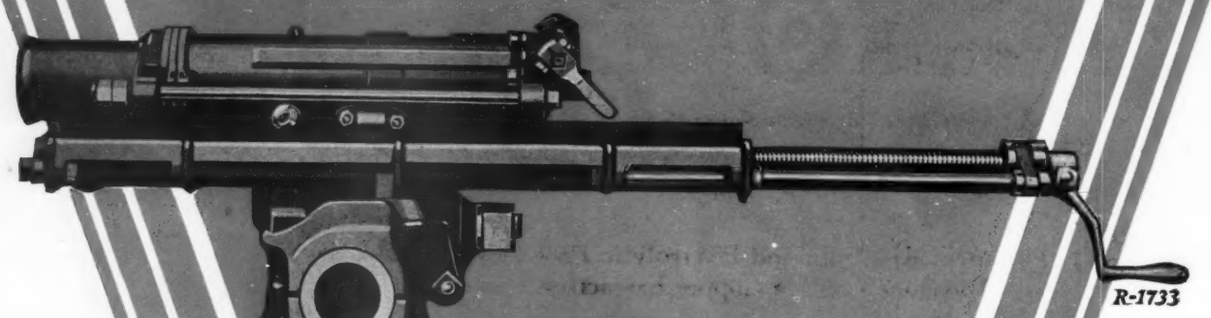
Potash Deposits in the Urals

Proper Designation of Mine Workings

Developing a Flotation-Leaching Process

Corrosion of Rabbles in Zinc Roasting

J. V. N. Dorr—Douglas Medalist



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Newhouse Crusher has Unrestricted Receiving Openings allowing Large Feed

ONE 7-inch Newhouse crusher, operating in closed circuit with a scalping screen, is handling the oversize from this pit. The material from the 24-inch belt conveyor, operating at approximately 280 feet per minute, is screened, the minus 2-inch ring size is bypassed and the oversize goes to the crusher. Much of the oversize consists of granite boulders, many of them having a one way dimension little less than the width of the crusher receiving opening. Notwithstanding this large feed, the crusher operates without bridging. This is due to the crusher's short rapid crushing stroke which also gives large unit capacity.

The few working parts, absence of gears and general simplicity of the Style "B" Newhouse crusher makes it a very economical machine to operate. Suspending the crusher by cables from the framework of the building eliminates expensive foundations and reduces installation costs. Built with receiving openings of 7, 10 and 14 inches.

Bulletin 1469 describes this *crusher that needs no foundations.*

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Milwaukee, Wisconsin

ENGINEERING AND
MINING JOURNAL

A McGRAW-HILL PUBLICATION — A. W. ALLEN, *Editor* — ESTABLISHED 1866

VOLUME 128 — New York, November 30, 1929 — NUMBER 22

Boasting, Complacency, Panic Are Equally Dangerous

WILL ROGERS, in his daily quip published in the New York *Times*, recently interpreted an important conference thus: "Railroad men of the country held a meeting at Washington and decided to put on more bus lines"—a statement that but thinly masks, with cynical humor, recognition of a lack of foresight in the past on the part of many high railroad executives.

A visitor to this office not long ago came in the hope of confirming a suspicion he held that one of the basic industries of the United States had been inconceivably stupid in its propaganda policies. We demurred at the suggestion that any responsible official in that particular group would risk exposure and adverse public opinion by so crude a treatment of a delicate problem as that described. Our objection was overruled, however. No limit can be set, we were assured, to the length to which some big-business executives may go in courting disaster by ill-considered action or inviting failure by lack of initiative.

Why these occasional lapses in high places? One reason may well be found in a personal preoccupation in the national pastime of stock-exchange speculation. Too much of the "working day" is spent in a feverish study of the ticker tape, in discussing possible and probable fluctuations, and in nervously awaiting calls from brokers by local and long-distance telephone. Industry suffers in consequence. Executives become as temperamental as opera stars. As Mr. Ford said, the United States is suffering from a serious withdrawal of brains from business. The state of the emotions of speculators dictates the immediate industrial condition and has a powerful influence on its future status. Despite fundamental soundness, psychology rather than fact has the major effect in disturbing the economic equilibrium.

This condition is a dangerous one, for it serves to encourage but two states of mind—complacency or panic, either of which is as bad as the other. In time of stress, business develops neurotic tendencies, which accentuate depression by infection. Complacency, on the other hand, refuses to accept the thesis that anything may happen any minute, that change is as inevitable as death and taxes. To have achieved success, technical and industrial, to serve many contented clients and customers, to make profits, and to see a reserve of those factors that one may blindly hope will insure prosperity for many years to come—this is not enough. A competitor or a competitive product may appear overnight, as it were, and the sense of security will promptly be replaced by one of depression.

The remedy for the present hysterical state of American business is more research—into fundamental facts and principles, into technical and market opportunities. In recent years too much time has been spent in boasting of a prosperity that has been distributed impartially among those who have earned it worthily by promoting the progress of their business and their industry, as well as among those whose principal thought has been the status of their own personal bank accounts.

Character and Control as Construction Factors

A DISTINGUISHED ARTIST when asked what vehicle he mixed with his paints replied with the single word "brains." In responsible technical work one assumes the possession of brains by the designer. In addition, however, the great engineering venture of today needs character, plus the courage that is derived from conviction based on definite knowledge of actual performance.

These thoughts were prompted by a recent acquaintance of what engineering skill has planned at Trenton, New Jersey, and is putting into execution in New York City and across the Hudson River—a bridge of astounding proportions, to be suspended from cables no less than thirty-six inches in diameter, each composed of twenty-six thousand galvanized steel wires. The span is over three thousand feet. Towers at each bank rise over six hundred feet from the ground.

The contract for the wire cable needed for this gigantic enterprise called for an expenditure of over $13,000,000, yet the order has seemingly failed to upset the regular routine production of the Roebling plants, founded a century ago by an immigrant engineer from Prussia. In the intervening time the name Roebling has been associated with fine achievement, especially in that type of bridge building that employs steel cables. The Brooklyn Bridge is an example of Roebling performance; the railroad bridge at Niagara, another; the span across the Ohio at Cincinnati, still another. But for sheer audacity of design and construction the new bridge across the Hudson River compels admiration and prompts a study of the component factors, material and immaterial, that go into the making of giant cables such as will be used for the colossal task of supporting a roadway and eventually a railway across so great a span. With speculation replaced with a feeling of certainty as to successful achievement, and seeing no end to ambition, the question was asked, "Next you will span the Golden Gate?" which brought the modest reply, "Quite probable."

Two features of special appeal mark the manufacture

of the wire to be used and being used in the construction of the Hudson River cables—standardization of product during fabrication and check control by testing. The various operations of steel making, rolling, annealing, baking, drawing and re-drawing, galvanizing, and spooling, offer evidence of the importance of large-scale production and accurate control by positive test. Suffice to say that a steel ingot weighing several tons finally emerges as a wire about one-fifth inch in diameter, which, after galvanizing, is shipped to the site, where foot bridges have been swung from pier to pier as working platforms.

The wise choice of words will facilitate an understanding of a complex operation. A false impression of the ultimate structure of the Hudson River cable is conveyed by designating the construction as a "spinning" operation, which implies twisting. As a matter of fact, the wires are merely laid parallel and close to each other, from anchorage to anchorage, and over the saddles at the summits of the towers. Smaller, individual cables are first formed, to be compressed later into the giant thirty-six inch cables that will support the roadway and railway structure beneath them. Incidentally, the laying of the cable strands will occupy from two to three years.

The reputation of the Roebling company is worth more than the profit from any one contract, however large it may be. Pride of performance engenders standards of craftsmanship and inspection that make failure an impossibility. The accumulated knowledge of a century of rope building will be capped by an achievement that will automatically reduce accident in every industry that uses wire rope. The mining industry, in particular, will benefit from the research and skill that carry beyond perception the horizon of possible human accomplishment.

The Old-Time Prospector, the Flivver and Airplane

THE mining industry has been graced and benefited by the prospector—a romantic personage. His discoveries are news features and his life is the theme of writers. With burro loaded with pick, shovel, pan, blankets, and provisions, he is pictured. His own rugged personality, his sun-tanned, unshaven visage, his unquenchable hope of striking it in the "next beyond," afford a tonic to the city dweller and to those obsessed with the folderols of civilization.

A likable character is the typical prospector, sometimes a wonderful companion, pardner with the trapper and the trail finder. Many prospectors have been roughly treated by fate. Some have benefited by their discoveries. All have found in the outdoors something beyond the mere fortune that they were ostensibly seeking. What prompts the inner urge to adopt such a life?

The passing of the old-time prospector is frequently a theme for discussion at mining meetings. His trials and tough luck are commented upon. Some state that he is of the past, a legendary character. Then they throw wreaths upon his memory and deplore the hard fate of an industry bereft of its "spark plugs." *Engineering and Mining Journal* disputes this point of view. Although a certain type of prospector may have disappeared, it takes only the yellow glint of a nugget or the report of a rich find to stir the minds and hearts of many and to awaken the desire for quickly acquired wealth. The difficulties inherent to such a quest cool the ardor of some, but to others the danger and difficulty provide all the zest needed.

Recall the Klondyke rush. Contrast this with the air-borne prospector of Canada. Flivver supplants burro. Airplane supplants flivver. But apart from such mechanical means of transportation, the same dominating motive spurred and spurs the search, whether in the time of the Golden Fleece, in the days of '49, or the present mineral exploration of New Guinea and Canada.

So long as the individual can see the possibility of reward, so long will we have prospectors. Every mining man is a potential prospector. He materializes into such when opportunity knocks. No mining engineer worthy of the title fails to look at new or old country in the spirit of inquiry. A touch of odd color, a crystal in a rock, and out comes the prospecting pick. Almost all such inquiries are fruitless, but they are the natural expression of a mental attitude that looks to nature to satisfy the needs of mankind, whether for diamonds or gold; for lead, zinc, or copper; for limestone, or filtering clay. So long as the spirit of adventure shall endure, the prospector, the pioneer, the soldier of fortune will lead the way. And in their leading they will stimulate others to an interest in the undiscovered.

To Encourage the Dissemination of Scientific Knowledge

WITHOUT holding any particular brief for the various book clubs that are exerting an increasing influence among book readers, *Engineering and Mining Journal* is glad to indorse in principle the avowed aims of the most recent addition to such agencies, which will review and select books in the broad field of the natural and social sciences. As pointed out a few weeks ago in these columns, the acquisition of sound scientific information by the general public is of vital importance. For this reason, particularly, the formation of the new book club is commendable.

Much information of a pseudo-scientific character is being disseminated, but few technical works intelligible and interesting to the layman are published. The new book club should restrict the market for the inaccurate and encourage an increasing supply of scientific works with appeal for the ordinary man. With editorial and advisory committees of the new club including such reputable and notable figures in their respective fields as Doctors Michael I. Pupin, Robert A. Millikan, Arthur A. Noyes, Edward L. Thorndike, and Kirtley F. Mather—to mention only five of the sixteen members of international standing in scientific circles who comprise the membership of the two committees—the public should have the benefit of sound advice in its scientific reading.

"Man," says Sir Arthur Keith, eminent scientist and president of the British Association for the Advancement of Science, "has no inborn love for scientific knowledge. A taste for it has to be developed." Any effort that aids in bringing about a more popular interest in scientific achievement is worthy of encouragement.

A Suggestion to Busy Managers and Superintendents

REQUEST for an article, made to the general superintendent of a prominent American mining company, elicits the reply that our letter has been referred to the junior members of the staff with a word of encouragement to write articles and the promise of co-operation by the manager in editing them. This plan is eminently satisfactory to us and will be advantageous to the company in question. Very often, some of the junior members of the staff are in closer touch with the details of practical operations than is the manager himself. The practice in writing aids them in the art of making informative reports, and, in clarifying their thoughts, spurs them to further research and study on the subject under review, to their own advantage as well as to that of their employer. A junior engineer should be proud of having his name published as the author of an interesting article, and the publicity thus secured is likely to redound to his advantage at an unexpected time.

The company official should, of course, be given an opportunity to edit the manuscript, a form of review not necessarily limited to editors. He can add here and there the touch born of mature experience, and elide any parts that might in any way prove injurious to the company's interests. Where he contributes a material share of the work, his name, of course, should rightfully appear as joint author.

To busy managers and superintendents we therefore suggest that they send a marked copy of this editorial to their junior staff, with a word of encouragement to go ahead. And to members of the junior staffs who may chance on these paragraphs, we suggest that they ask their superior officer if he will not be willing to co-operate in helping them take one of the first steps on the road to personal recognition and technical distinction in their chosen profession.

American Engineers in the Employ of Soviet Russia

IN THE issue of Nov. 16, *Engineering and Mining Journal*, in discussing "American Engineers in Russia and the Claims of Russo-Asiatic Against the Soviet Government," took the stand that industrial progress was better than economic chaos and that the only chance of the settlement of the claims made by the British corporation against the Soviet lay in constructive and productive work by the Russian people, under the direction of experienced engineers. It deplored the action of the Soviet in confiscating properties developed by foreign interests, and agreed that those interests were entitled to protest at its action in hiring American engineers to put the properties on a producing basis without consultation with the rightful owners. It re-stated the fact that the adoption of communism in Russia prevents and will prevent the return of properties to Russo-Asiatic, and it urged that public opinion and official action in the United States should be exerted to insist that the rehabilitation of the non-ferrous industries of the U.S.S.R. should be followed by the payment of the claims made by those who pioneered in bringing the industry to the status in which it existed before the revolution.

This attitude has met with opposition from Mr. F. Lynwood Garrison, of Philadelphia, whose criticism appears in another part of this issue and who characterizes the editorial in question as one of the most extraordinary statements he has ever seen in a reputable technical publication. This is so common an introduction, designed to shame an editor, that it may be passed without comment. The editorial was written by one who knows little of Russia, he avers, admitting later himself an ignorance of the abbreviation "U.S.S.R."

Mr. Garrison brands as unworthy and illogical the attitude of *Engineering and Mining Journal* in holding that, as the return of the properties is apparently out of the question—admitted by the chairman of Russo-Asiatic—one can well hope that the rehabilitation of the non-ferrous industry through the help of American technicians and engineers will hasten the day when compensation will be made for the seizure of the properties; urging, in addition, the stimulation of an enlightened public opinion in the United States, backed by government pressure, to influence this outcome. *Engineering and Mining Journal* cannot accept Mr. Garrison's criticisms. It regrets that he has stigmatized American engineers in the employ of the Soviet in terms almost as harsh as those used to voice an opinion of the Soviet government itself.

No good can come of sweeping denunciation—of criticism bereft of constructive suggestion. Default in meeting monetary obligations, or in honoring national currencies, is not a monopoly of modern Russia. The repudiation of bond obligations for immense amounts incurred by the Southern states during the Civil War is a case in point. The result of this default is a smoldering resentment on the part of European lenders, which is fanned into harsh criticism when repayment of the more recent war-debt obligations, in the reverse direction, is raised.

Anyone who doubts that an industrial experiment of vast proportions is in progress in Soviet Russia should turn to page 866 of this issue, where he will find data, supplied by our Washington correspondent, describing what American methods and American engineers are now doing in that country. Mr. Garrison is entitled to his opinion that the "schemes" are "largely fantastic," but his letter does not bear evidence of a familiarity with conditions in Russia that he infers in the opening paragraph.

In conclusion, Mr. Garrison calls on respectable engineers and respectable engineering publications to support Mr. Urquhart, the chairman of Russo-Asiatic. This is precisely what *Engineering and Mining Journal* has done in urging a recognition of the financial obligations of the Soviet towards his company. But it "does not believe that any engineer should be held responsible for the past misdeeds of a prospective employer, unless he is convinced that neither moral obligation nor outside pressure will ever force that employer to live up to his promises." It can see nothing logical or worthy in urging a cessation of American participation in the task of rehabilitating Russian industry, leaving that unhappy country to a fate that will encourage indefinite continuance "of a condition of poverty that so frequently is a fundamental cause of failure to meet monetary obligations."

M.I.T. MINERS AT

Each summer mining eng
Massachusetts Institute of
weeks at the camp the in
Dover, N. J. Eight we
surveying and on
studying min

Above—The students and faculty members who attended the camp last summer. W. Spencer Hutchinson, professor of mining, at the Massachusetts Institute of Technology, is seen at the right end of the front row.

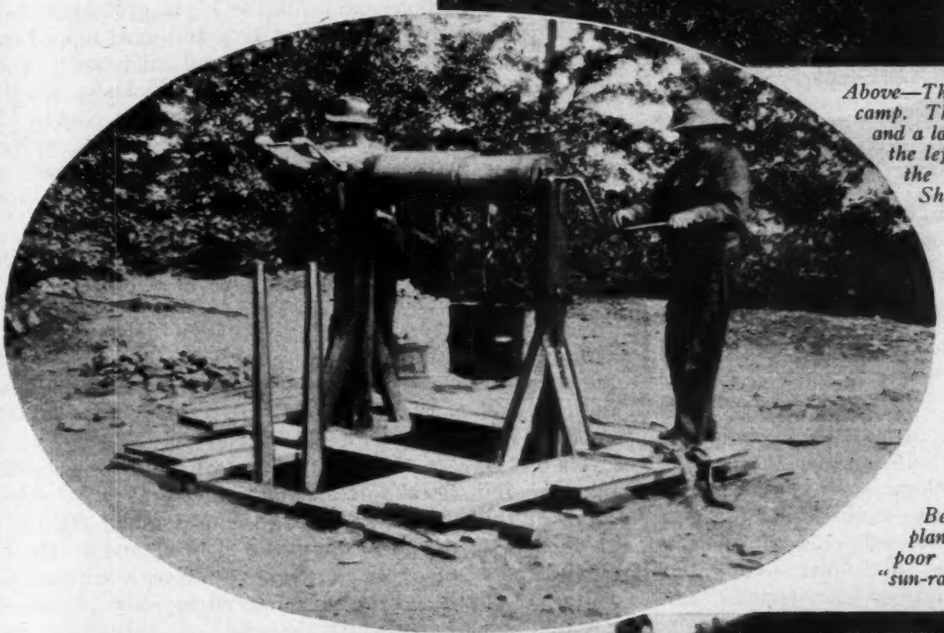
Above—Field work with the Berg magnetometer.

Below—Hoist house, headframe, and magnetic concentrator of the Richard iron mine, operated by the Thomas Iron Company. This mine is three miles from the camp, and is producing 300 tons of concentrate daily from a deposit that has been worked continuously by the Thomas company for more than seventy years.

THEIR SUMMER CAMP

ineering students from the Technology spend nine stitution maintains near eks are devoted to mine e week is given to ing practice.

Above—The administration building at the camp. The central portion comprises offices and a large lounging room with fireplace; the left wing, drafting and class rooms; the right wing, the dining room. Shower baths are in the basement.



Below—Chasing contours with the plane table. Evidently the camp is poor territory for salesmen handling "sun-ray" lamps.

Above—A prospect shaft at the Richard mine that is being sunk to a magnetic orebody beneath 40 ft. of glacial drift. The orebody was discovered by magnetic surveys made by students two years ago.

Potash Deposits *in the Urals*

W. P. KOTCHETKOFF

One of the development shafts in the Solikamsk area

SYLVINITE was discovered in 1916, in samples of rock salt extracted near Solikamsk, in the province of Perm, Ural. The Geological Committee in 1917 began a study of potash resources in the Solikamsk area.

The brine of the rock salt contained potassium chloride, particularly in the holes bored at Solikamsk and Ust-Borovaya, where deep exploration was started. This work was interrupted by the civil war, and funds for boring purposes were obtained only for the operative year 1924-25.

Exploration work was organized in the summer of 1925. On Oct. 10 of the same year the first hole was bored on the right bank of the river Usolka, northwest of Solikamsk, to a depth of 95 m. The presence of sylvinite was discovered at a depth of from 91.7 to 92.30 m. An analysis at the laboratory of the Geological Committee showed the sample to contain 11.30 per cent K_2O.

Solikamsk, on the Kama River and about 200 km. north of Perm, is a small town of 4,000, situated in a sparsely populated territory. Since the fifteenth century Solikamsk has been known for its salt mines, which constitute the only industry of the district.

The river Kama, at Solikamsk, is navigable. In the spring, during the overflow of the river, boats and barges of a draft up to 2.8 m. enter the harbor. At other times of the year only small boats enter, of a draft up to 1 m.

Solikamsk is connected by railway (via Usolye-Perm) with the Northern trunk line Leningrad-Perm-Siberia, and also with the railway lines of Perm-Sverdlovsk, Kazan - Moscow, and Tchelyabinsk - Ufa - Tashkent (Turkestan).

The district explored for potash is covered by layers representing a continuation of the Perm geological system. Surface layers consist of lime and marl topped by strata of brownish-red marl, clay, and sandstone. The lime and marl layers reach a great thickness at all eminent points on the surface near the town of Solikamsk. Upon the left bank of the Kama, within the area of the works, the marl and sandstone are a good deal thicker. Some boring was done on these layers.

In main outline, the strata above the salt deposits may be characterized as follows: (1) alluvium (15 to 20 m.), absent at elevated spots; (2) lime and marl (49.19 m.); (3) clay and marl, from 35 to 122 m., average about 70 m.; (4) gypsum, 8 to 40 m. At places the presence of gypsum is limited to streaks embedded in the clay and marl. As a rule, the presence of gypsum indicates the proximity of salt.

The first layers of the salt consist of muddy-gray rock salt with thin streaks of anhydrite and gray clay. The depth of the covering salt varies considerably, fluctuating in some of the pit holes from 3 to 12 m. and in others from 30 to 47 m. Finally, the covering rock salt passes on to the potash. First encountered in some places is carnallite, but frequently, instead of carnallite, its derivative is found, a secondary sylvinite containing almost no magnesium. Sometimes the primary carnallite is found directly beneath the rock salt; but more frequently it lies beneath the secondary sylvinite. Usually it is of orange-red color; rarely it is tinged in lighter hues, down to a lemon-yellow shading. The depth of the carnallite zone is about 80 m. In this zone the layers of consistent carnallite alternate with rock salt, which also contains potassium salts.

Explorations disclosed the fact that the lower sylvinite zone consists of almost pure sylvinite of a red color, deposited in thin layers alternating with streaks of rock salt of blue, white, or more frequently, muddy-gray color. The exterior appearance of extracted samples and the abundance of red sylvinite in them enable one to judge the proportion of potash. Sylvinite, on the average, is richer in potash than is carnallite. The depth of the lower sylvinite zone is about 30 m.

The "lower" rock salt is beneath the sylvinite zone. Of the eighteen holes bored, the lower salt layer has been surveyed only in two. In other holes the rock salt has been surveyed only to a depth of 118 to 130 m.

This salt is of muddy-gray color, homogeneous, and streaks of pure white or slightly roseate salt up to 1.5 m. in thickness are but rarely encountered.

A comparison of samples taken at various depths in the pit holes enables one to form an idea about the displacement of the upper surface of the salt layer, here and there, to a depth, for instance, of 184 m., instead of 80 to 100 m., which is the normal depth for the neighboring holes. In places the layers are rather crumpled, but the general character of the deposits shows this crumpling to be a casual phenomenon.

Eighteen holes in the area of the potash deposits have been surveyed, of which twelve holes (from 252 to 473 m. deep) are near Solikamsk. The other holes (from 396 to 716 m. deep) are south, in the Berezniki district. In the immediate vicinity of the holes the explored area comprises about 60 sq.km. The total area under exploration is not less than 600 sq.km. Moreover, the presence of potash in brine beyond the boundaries of this area (not less than 90 km. north of Solikamsk) gives reason to assume the total area of the potash deposits to be considerably larger.

All the holes bored have shown the homogeneous character of the deposits. On the basis of analysis an average of 10,000,000 tons of potash in the equivalent of potassium oxide (K_2O) to 1 sq.km. of salt deposit is assumed. Thus, upon the carefully explored area of 60 sq.km., 600,000,000 tons of potassium oxide is indicated, or 3,500,000,000 tons of crude potash salts (sylvinite and carnallite).

In the Solikamsk holes the alluvial drifts run to a thickness of 2 to 33 m. (average 18 m.); at Berezniki, 5 to 17 m. (average 11 m.). Layers of rock below the alluvial drifts at Solikamsk are from 49 to 202 m. (average 104 m.); and at Berezniki, 109 to 162 m. (average 132 m.). At Solikamsk the upper common salt is 1 to 56 m. (average 20 m.), and at Berezniki 22 to 138 m. (average 58 m.) in thickness. The upper sylvinite and carnallite zones at Solikamsk are 48 to 100 m. (average 77 m.); and in the Berezniki area, 44 to 86 m. (average 69 m.). The lower sylvinite zone is from 13 to 43 m. in the Solikamsk area (average 28 m.), and from 12 to 69 m. in the Berezniki area (average 20 m.). Thus, both districts are much alike as regards the thickness of the potash zones.

The Berezniki area lies nearer to the Kama River but on marshy soil inundated in the spring by the overflow of the Kama. In the Solikamsk area is a dry territory 2½ km. south of Solikamsk and 4½ km. from the river Kama. This territory was chosen for the first two pits.

The working layers in both the sylvinite and carnallite zones total about one-half of their thickness, as may be seen from Table I, in which the average content of potassium chloride in the working layers is shown.

Table I—Potash Content in Working Layers

Carnallite Zone	Hole No. 2	Hole No. 3	Hole No. 4
Depth below surface of soil, m	103.13 to 185.6	104.14 to 183.55	232.25 to 308.88
Total thickness of zone, m	82.47	79.41	73.08
Number of working layers	12	8	10
Total thickness of working layers, m	44.31	41.93	33.28
Average content KCl, per cent	15.21	21.88	23.4
Lower sylvite zone			
Depth below surface of soil, m	188.87 to 220.09	183.55 to 209.0	311.28 to 325.88
Total thickness of zone, m	31.22	25.45	14.60
Number of working layers	4	5	4
Total thickness of working layers, m	16.17	13.59	7.66
Average content KCl, per cent	25	25.95	22.3

These three holes embrace the more typical cases. Holes Nos. 2 and 3 are typical for the exploitation pits now being surveyed. Hole No. 4 represents a deep salt bed and is 6 km. north of the pits. The similar character of the beds is confirmed by all the eighteen holes.

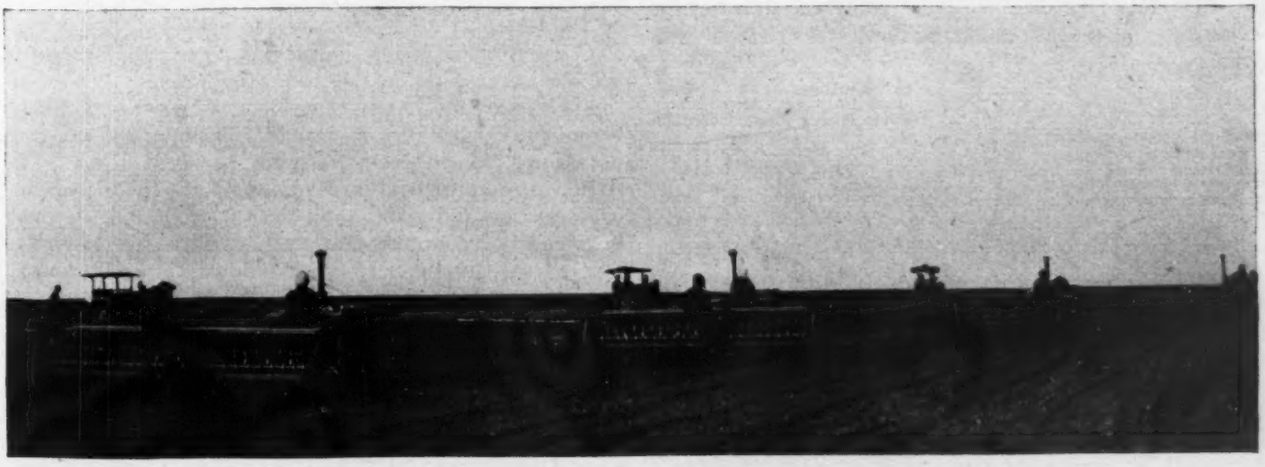
Taking the average thickness of the working layers (in the carnallite zone) at 35 m., with a 20 per cent content of KCl, and in the sylvinite zone at 12 m., with a 24 per cent content of KCl, Prof. P. I. Preobrazhensky

Table II—Analysis of Solikamsk Sylvinite and Carnallite as Compared With Stassfurt and Alsace Salts

	Solikamsk Carnallite Hole No. 8, Depth of Layer: 108.57 to 114.4m.	Stassfurt Carnallite, Average	Alsatian Carnallite (Sebkainite)
Magnesium chloride, per cent	25.88	20.4	27.2
Potassium chloride, per cent	23.55	16.0	19.5
Chemically compounded water, per cent	28.03	23.2	34.0
Sodium chloride, per cent	20.60	24.0	10.0
Magnesium sulphate + Insoluble residue, per cent	.....	12.0	9 3
Anhydrite, per cent	1.46	2.6	....
Hygroscopic water, per cent	.....	1.8	....
	99.52	100.0	100.0

	Solikamsk Samples from Holes Nos. 2 and 8	German Sylvinite According to Feit
Sylvinite, per cent	18.45 to 44.14	28.0 to 40.0
Carnallite, per cent	.....	0 to 0.5
Magnesium chloride, per cent	0 to 0.28	.....
Kieserite, per cent	None	0.1 to 1.0
Anhydrite, per cent	0.92 to 3.7	0.1 to 1.0
Common salt, per cent	53.1 to 78.3	5.7 to 70.0
Insoluble residue, per cent	0.27 to 2.16	0.1 to 0.5

Modern agricultural methods applied in Russia. The spread of these methods is expected to increase the market for potash.



estimates the average yield per 1 sq.km. of the carnallite zone at 7.96 million tons of potassium oxide (K_2O), and in the lower sylvinite zone at 3.5 million tons; altogether a total of 11.46 million tons. Taking a round figure, the average yield on the explored area is estimated at 10 million tons of K_2O per square kilometer.

The absence of kieserite in the Solikamsk salts constitutes an advantage in the process of extracting concentrated salts by means of recrystallization. The Solikamsk potash deposits contain on the average two-thirds carnallite and only about one-third sylvinite. Sylvinite, being free from magnesium, may serve as a ready fertilizing salt, whereas carnallite requires complex treatment by means of recrystallization. For this reason the extraction and concentration of sylvinite are of great practical importance. The conversion of carnallite is connected with the question of utilizing its content of magnesium, as well as iodine and bromine.

Plans have been made for the building of the plant for the recrystallization of the concentrated salts during the season of 1930-31, with first output during 1931-32. Concentration of the sylvinite may be carried out to a considerable extent by means of hand picking. The bulk of the sylvinite coming from the mines contains on the average about 24 per cent potassium chloride, or 15 per cent K_2O. The salt may be used thus to fertilize the soil for all crops except a few which need concentrated salts. However, if the fertilizing salt has to be carried more than 1,000 km., to use more concentrated salts containing 30 to 40 per cent K_2O is economically more profitable.

In the raw sylvinite the lumps of sylvine are easily distinguished by their red color, with a slight admixture of common salt, and the white or gray lumps of common salt with a small admixture of sylvinite. By picking the common salt on a conveyor, concentrated sylvinite can be obtained containing 30 per cent K_2O. Under this process 2.7 tons of crude sylvinite must be used to obtain 1 ton of concentrated sylvinite (30 per cent K_2O).

After the erection of the crystallizing plant, salt containing 30 per cent and 40 per cent K_2O, as well as potassium chloride for exports (50 to 53 per cent K_2O), will be obtained by recrystallization.

Conditions for the recrystallization of the Solikamsk salts have been studied by Professor Yefremov and F. Wolf at the Central Laboratory of the Northern Chemical Trust. Tests have been made chiefly on sylvinite of different quality under various conditions of recrystallization. Normal sylvinite treated with saturated brine at a temperature of 90 to 100 deg. C. was passed through a filter and then quickly and artificially cooled. The small crystals thus obtained were analyzed, showing the following content as compared with the original sylvinite:

	Sylvinite from Hole No. 8 (256 to 262 m.)	Salt Obtained After First Recrystallization
Potassium chloride, per cent	23.70	99.20
Sodium chloride, per cent	73.50	0.72
Anhydrite, per cent	1.53	0.06
Magnesium chloride, per cent	0.05	Traces
Insoluble residue, per cent	1.14	.....
Water, per cent	0.07	.....
	99.99	99.98

Another series of tests was made with samples of sylvinite from hole No. 2 (depth 209 to 219.98 m.). Two samples of working sylvinite of varying potassium content were taken, and the conditions of recrystallization studied. After saturation at a temperature of 95 to 96 deg. C. and cooling down to 10 to 15 deg. C. (or 113 deg. C. and cooling down to 20 deg. C., respectively),

Table III—Analysis of Recrystallized Sylvinite

	Sylvinite I, Per Cent	After First Recrystallization of Sylvinite I Under 95 to 96° C., Per Cent	After First Recrystallization of Sylvinite I Under 113° C., Per Cent	Sylvinite II, Per Cent	Salt from Sylvinite II Under 95° to 96° C., Per Cent
Potassium chloride	48.59	95.88	97.28	18.45	81.88
Sodium chloride	49.68	4.12	2.72	78.23	19.62
Magnesium chloride	Traces	Traces	Traces	0.20	0.25
Anhydrite	1.23	Traces	Traces	2.21	0.48
Insoluble residue	0.49	.....	.....	0.91	0.19
	99.50	99.99	100.00	100.00	102.42

the two samples (I and II) were analyzed. The analysis of the salts is shown in Table III.

The samples of sylvinite, whether rich or poor in potassium, easily yield, after the first recrystallization, a potassium chloride of the quality required for technical purposes. Such favorable results are attributable chiefly to the absence of magnesium in the soluble sulphates.

Preparations for the exploitation of the Solikamsk potash deposits were started at the end of 1927 when the first shaft was sunk by the Russian "Kali Trust" with the consultation of the *Gefrierschachtbau*, of Germany. When a depth of 78 m. was reached in the autumn of 1928, it was found necessary to carry out complex work on cementing and reinforcing the stem of the shaft by means of tubbings. An additional contract was then signed with the same firm for further surveying to a depth of 30 m. of salt. In May, 1928, a second shaft was sunk in the neighborhood, the work being conducted by the same German firm. The freezing method was applied. Extraction of salts by the first shaft (the second being used for ventilation) will be started, according to the plan, in 1929-30.

The plan drawn up by the "Kali Trust" for the next three years provides for the erection of a special salt mill during 1928-29, and of a concentration plant during 1930. Late in the 1929-30 season a central electric power station, water system, mine transportation facilities, warehouses, and other structures will be completed.

The full output of the first working shaft should reach 1,100,000 tons of crude salt annually, a quantity considered inadequate to fill the domestic requirements calculated for 1932-33 at 1,500,000 tons of sylvinite. Moreover, a further 500,000 tons of sylvinite will be required by the chemical industry of the country. Therefore, plans have been made to start sinking a second working shaft in 1930 near the first shaft. The ventilation shaft will take care of both working shafts.

Thus, starting first with one working shaft and proceeding to the construction of a second, the following plan for the extraction of sylvinite is contemplated: In 1929-30, 30,000 tons; in 1930-31, 250,000 tons; in 1931-32, 500,000 tons; in 1932-33, 1,500,000 tons; and in 1933-34, 2,200,000 tons.

Conversion of crude salts into commercial products will be carried on in the following grades: (1) Sylvinite containing 15 per cent K_2O; (2) potassium salts containing 30 per cent K_2O, and (3) export 85 per cent potassium chloride containing 54 per cent K_2O. The first two products will be obtained by means of mechanical selection and grinding in the salt mill, and the third by means of concentration at the plant. The calendar plan of the commercial output follows (in 1,000 tons):

Years	Sylvinite 15 Per Cent K_2O	Potassium Salts, 30 Per Cent K_2O	85 Per Cent Potassium Chloride, Containing 54 Per Cent K_2O	Total
1929-30	30	...	...	30
1930-31	250	...	...	250
1931-32	500	...	...	500
1932-33	226	400	100	726
1933-34	320	615	170	1,105

In view of the geographical location of the potassium mine and the economic conditions of transportation, 60 per cent of the commercial products will be shipped by rail and the remaining 40 per cent by waterways, both in bulk.

The organization of the potash mines and works belongs to the "Kali Trust," which is financed and controlled by the Supreme Council of National Economy (VSNH) of U.S.S.R. The "Kali Trust" is combined with the All-Union Chemical Syndicate, which receives from the potash trust the whole of its output and disposes of it both in the home and foreign markets.

Allocation of the output in the home market for industrial and agricultural purposes is carried out in accordance with the plan of distribution among the different consuming and trading organizations.

Flotation, Roasting, and Electrolytic Problems in the Development of a Copper Extraction Process

CHARLES T. BAROCH

ABOUT three years ago the Bagdad Copper Corporation, with a property near Hillside, Ariz., began work on the development of a process for treating its ore. Most of this ore consists of primary chalcopyrite in a slightly basic porphyry, with chalcocite as a secondary enrichment. About 30,000,000 tons was estimated to be available, of a grade between 1¼ and 1½ per cent copper.

Concentration by flotation was first considered, and excellent recoveries were made, with a concentrate running from 25 to 30 per cent. However, a 26-mile haul to the railroad would be necessary on a product only one-quarter of which was copper, so attention was directed to the possibility of making electrolytic copper. This involved roasting and leaching, and experiments of this nature were carried to a successful conclusion by H. E. Wetherbee. The process outlined in the laboratory work consisted of (1) flotation; (2) roasting of the concentrate; (3) agitation with sulphuric acid; and (4) electrolytic precipitation. A pilot plant was started in 1928, the concentrator being finished in January, 1929, and the other three units at the end of March.

THE CONCENTRATOR is a 50-ton factory-built plant. Ore is hoisted from the mine along a 480-ft. two-way tramway, by an electric hoist, and passes through a 6-in. hand grizzly into a 25-ton surge bin. This 6-in. ore is reduced to 1 in. by a jaw crusher and elevated to a 50-ton storage bin, from which a mechanical feeder carries it to a No. 55 Marcy ball mill in closed circuit with a Dorr classifier. A sand pump delivers the pulp to a rougher flotation cell, the tailing from which goes to waste. The rougher concentrate is cleaned, the cleaner tailing being returned to the rougher. The machines are of the Southwestern air type, without blankets, using air furnished by a No. 2 Roots blower. Excepting the jaw crusher, the entire mill is driven by line shaft and countershafts, powered by one 70-hp. synchronous motor.

Pine oil and Aërofloat were used as reagents, after trial with others. After two months' running a tailing thickener was installed to determine the effect of using reclaimed water. This cut the reagent consumption. A typical feed and concentrate assay follows: Feed, 1.28 per cent copper; concentrate, 33.50 copper, 24.2 iron, and 12 per cent "insoluble."

ROASTING of a concentrate containing over 30 per cent sulphur was expected to be troublesome. A simple reverberatory roaster was first built. This had a 7x12-ft. hearth, and was built of brick, with rabble door openings, and was oil-fired. It was unsatisfactory for the following reasons: Temperatures above 1,200 deg. F. resulted in making too much of the iron soluble in acid, and it was difficult to keep the heat of the ore below this without having a fine spray of oil dropping on the charge and producing localized centers with a reducing atmosphere. Hand rabbling was expensive, inefficient, and unreliable. Fuel efficiency was low, and air control, to secure the proper atmosphere in the furnace, was difficult.

The next step was the installation of a 5x8-ft. revolving cylinder Bruckner roaster. The cylinder is of steel, lined with firebrick, and is mounted on trunnion bearings. An electric motor, operating through a worm-gear mechanism, rotates the furnace once in three minutes, thus keeping the charge moving. An oil burner in a small auxiliary firebox at one end of the cylinder supplies heat.

Satisfactory results have been secured in this type of roaster, especially in the matter of producing a calcine low in acid-soluble iron. One bad feature, however, is the fact that the temperature at the rear end of the cylinder is about 200 deg. hotter than at the firing end, so that a proper temperature control throughout the furnace length is not possible. Therefore, those responsible for operation decided to install a third furnace of the multiple-hearth type. Anaconda's success with modified Wedge roasters for zinc flotation concentrate leads to the belief that equally good results can be secured on copper concentrate here.

Agitation equipment embraces two agitator tanks,

Abstract of a paper presented at a recent meeting of the Yavapai Chamber of Commerce at Prescott, Ariz.

6x6 ft., equipped with a vertically mounted propeller-type agitator (sometimes known as a Devereux or Goldfield agitator), one cone thickener, and two 8x6-ft. electrolyte storage tanks. An Oliver filter will be added. About half of the weight of the calcine dissolves, so that the problem of washing the tailing should not be difficult, so far as the prevention of an unduly large copper loss is concerned.

Electrolyte from the agitation plant contains from 55 to 60 grams of copper and 20 grams of acid per liter (approximately 6 per cent copper and 2 per cent acid). Return solution after electrolysis contains from 20 to 25 grams of copper, and 65 grams of acid per liter (2 per cent copper; 6½ per cent acid), and is used for the leaching of new calcine.

Water-soluble copper in the calcine, producing copper sulphate in the electrolyte and building up the acid in the return solution, makes it necessary to discard a certain proportion of the electrolyte. This passes to the stripping cells, where the copper content is reduced from 20 grams to about 5 grams, the last remaining copper content being recovered by scrap-iron precipitation. It is expected that this cement copper precipitated by scrap iron will amount to somewhat less than 5 per cent of the total copper produced.

The major electrolytic unit consists of sixteen cells arranged in four cascades of four cells each, and the stripping unit has eighteen cells in four cascades of four cells each plus two cells used as circuit resistances. These cells are of redwood, lined with antimonial lead. The nine starting-sheet cathodes in each cell are 20x22 in., and the ten cast antimonial lead anodes are slightly smaller. Spacing is 4½ in. between anode centers. Solution flows through the four cells in cascade in each cycle. Power is supplied by a 180-hp. Fairbanks-Morse Diesel engine, direct-connected to a direct-current generator having a capacity of 2,000 amperes at 40 volts.

The high-grade calcine produces an electrolyte of extreme purity and higher copper content than is in general use anywhere else so far as known. This results in a much smaller volume of solution per ton of copper, with accompanying lower costs of installation and operation; a lower power factor per pound of copper deposited; and a higher current density than would otherwise be possible. An electrolytic copper of 99.98 per cent purity has been produced.

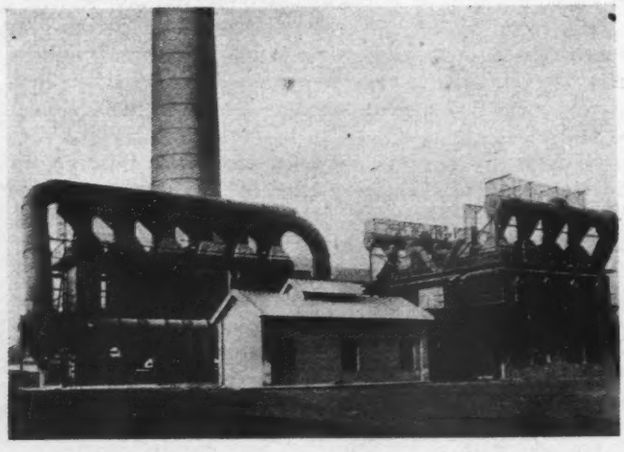
All starting sheets are made directly from the electrolyte, and not from cast copper anodes, as is the practice at many plants. A cast lead sheet is used for the cathode blank; the edges are painted with a quick-drying lacquer and the faces graphited to make stripping easy. Two starting sheets are made in two days from each blank, and hanger loops for the starting sheets are cut from the same material.

Savings by Electrical Fume Precipitation at German Smelters

IN AN article by Hermann Fiesel, on "The Application of Electrical Gas Cleaning in European Industry," that appeared in the first issue of the *Periodic Review* of the Metallgesellschaft, examples are given of important savings obtained by two plants following the adoption of the Cottrell process of fume precipitation. (Values are expressed in marks, 1 mark being equal to about 24c. in United States money.)

The lead works in question had a yearly output of 10,000 tons of lead. For the treatment of its ores it used American hearths, a few converters, and a blast furnace; and for the condensation of its flue dust it used a conduit 400 m. long, a wet condensing plant, and an old mine gallery 800 m. long, which served as a dust-collecting chamber. From the whole plant 850 tons of flue dust per year were recovered, containing about 60 per cent of lead of the value of 255,000 marks. The working costs of this mechanical dust recovering plant were 35,000 marks for wages and 43,700 marks for power, a total of 78,700 marks per year. The electrical gas-cleaning plant cost about 220,000 marks and recovered about 1,000 tons of dust per year, containing 65 per cent of lead of the value of 325,000 marks. Working costs were 10,000 marks for wages and 33,700 for power, totaling 43,700 marks per year. The annual gain resulting from the change amounted to 130,500 marks, made up as follows:

	Marks
Additional gain in lead	70,000
Savings in wages and power costs	35,000
Interest saved on dust deposits lying dead during the year by the old system	10,200
Saving of losses in transport of the mechanically recovered dust and losses through inferior smelting	15,300
Total	130,500



Two Cottrell plants, an early one and a modern one, at a European lead plant

After deducting 55,000 marks for interest and amortization of the costs of installation of the electrical gas-cleaning plant, a net annual gain of 75,500 marks remained.

In another lead works which formerly used nothing but large flues for the recovery of dust, the amount recovered by these means had an annual value of 402,000 marks. After the installation of an electric gas-cleaning plant the value of the dust recovered rose to 637,000 marks annually. The electrically recovered dust contained 66 per cent lead, whereas that recovered mechanically contained only 60 per cent. Especially remarkable was the enrichment of the dust in silver, which amounted to 131 kg. per ton of electrically recovered dust, whereas the mechanically recovered dust held only 73.5 kg. of silver per ton.

FOR DISTINGUISHED ACHIEVEMENT *IN NON-FERROUS METALLURGY*

The James Douglas Medal, commemorating Dr. James Douglas, twice president of the A.I.M.E., has been awarded to John Van Nostrand Dorr. The formal presentation will probably be made at the annual banquet to be held in New York during the latter part of next February. The award, established by anonymous donors in 1922, has been given to the following: 1923—Frederick Laist; 1924—Charles W. Merrill; 1925—William H. Bassett; 1926—John M. Callow; 1927—Zay Jeffries; 1928—Selwyn G. Blaylock.

After an initial experience in an atmosphere of invention—J. V. N. Dorr was an assistant in Mr. Edison's laboratory in the late 90's—the recipient of the James Douglas Medal for 1929 graduated from Rutgers College in 1894, and then acted as chemist, assayer, and metallurgist for various companies in the Dakotas and Colorado.

The period covered was one of the most interesting and most productive in the history of the metallurgy of gold. The cyanide process was being widely adopted. Equipment of all kinds was being invented, some good and some bad. Two pieces of apparatus, however, have since become standard in all parts of the world, being used in a score of operations far removed from the original application. These are the Dorr classifier and the Dorr thickener — continuous machines the unit size of which in special installations has grown to amazing proportions. They constituted and still constitute a dual contribution that has played one of the most important parts in hastening the transition from intermittent to continuous operation. For his contributions to technology Mr. Dorr received the John Scott Medal of the Franklin Institute in 1916 and the honorary degree of D.Sc. from Rutgers College in 1927.

Writing a decade ago to a colleague, Mr. Dorr sketched the genesis of his mechanical classifier: "A mill—in which three men with more faith than anything else had put practically all their funds and had borrowed to the limit from friends, banks, and the labor union—was steadily losing money, largely because of difficult classification and the production of sand that would not leach, and a slime product badly contaminated with sand. Pre-

J. V. N. DORR

liminary experiments had indicated the practicability of mechanical classification. One Sunday afternoon we were working around the 22-ft. settling cone, to stop the foam from overflowing. One of the boys, walking on the rim, threw it out of a delicate equilibrium. The foundations were weakened by spills. Down it dropped, on the point of the cone, spilling probably one-third of the slime pulp it carried, and nearly washing the plant down the hill.

"It was a critical moment for us. You can imagine how discouraging a crumpled-up cone would look to men who felt that uninterrupted operation was absolutely essential to stand off the creditors. There was nothing to do however, but to 'go to it.' Recognizing that a week or ten days must pass before things could be straightened out, we decided to burn our bridges on the classification problem. We took out two cones, a Frenier pump, and a wet elevator, and designed a commercial size mechanical classifier based on a few weeks' small-scale experimental work. We went at it boldly, and by the time our cone was picked up we were ready to operate. Dimensions and slopes had been guessed at. When the machine started it would do good work for perhaps half an hour, and then clog up and quit. I myself spent about sixty hours on the job, lying down for naps while alterations were being made. Its delicacy at that time was such that while able to handle continuously one ore, when called upon to handle another ore, mined a short distance from the first, the machine would shut down. When the adjustments were made, however, it ran continuously, converting a monthly deficit into a profit."

The object of good engineering is to turn deficits into profits. Doctor Dorr, to use an appellation to which he is entitled but by which he is not known among his friends, has made a conspicuous success with his inventions by building an industrial organization to carry out the research needed to utilize them to the best advantage. He is now the president of The Dorr Company, with subsidiary companies in London, Paris, and Berlin. Dorr processes and Dorr equipment are now standard in many technical and semi-technical industries throughout the world.

Doctor Dorr's life has been one of engineering alertness, leading to industrial success as well as full recognition of his many technical achievements. The possession of a broader and more artistic philosophy than is held by the majority of successful men is shown by his selection, in 1917, of an old grist mill, dating back almost to the Revolution, for his company's research plant. This building, situated near the Connecticut shore and about fifty miles from New York, was destroyed by fire in 1927. Memories persist, however. To be privileged to work among charming natural surroundings, to be away from the city's raucous din, to browse among the volumes of a well-stocked library, to be allowed to think in peace and without constant interruption—these are but a few of the advantages of Westport. And, given the historic background, a visit there, incidentally, provides another impression of the personality of J. V. N. Dorr.

The inventor, to be successful, must commercialize his inventions. Doctor Dorr has done this efficiently, with signal advantage to those who have not resisted the modernization program involved. The James Douglas Award is recognition of distinguished achievement in non-ferrous metallurgy, in the judgment of a capable committee of award. To many of his friends, however, he will always be remembered for his pioneer work in South Dakota, of far-reaching influence on general technical development and progress in many industries other than that concerned with the beneficiation of precious-metal ores.

A Well-Planned Numbering and Sketching System Facilitates Control of Underground Operations

ALFRED KWIECINSKI
Mining Engineer, Polish Upper Silesia

THE large scope and complicated arrangement of a modern mining enterprise often tax one's sense of location; hence a well-planned system of nomenclature or designation appears highly desirable. For convenience in preparing and reading reports and records, a pithy, unambiguous, and simple system of designation is essential. Descriptions such as "3d chute in the eastern cut of the 420-meter level" and "Veronika seam, 2d level, route 3, east," not only involve much time in recording and reading, but also require much space on the record forms, which should be of convenient size—a size not practicable if long descriptions are entered on them.

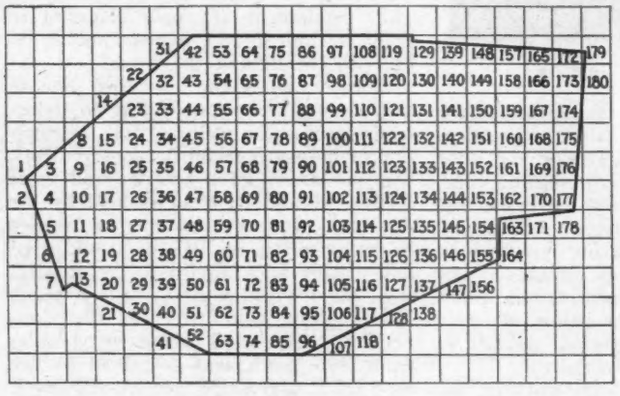


Fig. 1—The mining area is divided into blocks 100 m. square

A system complying with the demands indicated would greatly facilitate control of operations.

A complete absence of order in the recording of data characterizes operations in many mines. For example, one finds the same system-number transferred to a different section each month, thus necessitating a constant readjustment of memory on the part of all concerned. Then, one may find that the same designation is used in two or more parts of the same mine, causing frequent and embarrassing confusion in such matters as identification and payroll disbursements. Or, again, there will be a haphazard hodgepodge of capital and small letters, of roman and arabic numerals, not to speak of unnecessarily long descriptions explaining locations. Widespread prevalence of difficult and confusing designations is wholly unnecessary. A system is here described that is intended to make designation a help rather than a hindrance in mining operations. The basis of this system is a division of the entire mining terrain into rectangular blocks having their 100-meter sides parallel to co-ordinate axes and designated with consecutive numbers, as indicated in Fig. 1. The designation of any opening, working, or operation then consists, first, of the number of the block in which it is situated, and, second, of a supplementary Latin character, determined as follows:

(*a*) All secondary operations receive a lower-case letter; to avoid confusion, those that resemble capital letters in cursive script are underscored, for example, *m*, *n*, *o*, *u*, and *w*. By secondary operations are meant those which penetrate into and are surrounded by the deposit, but which do not serve primarily for exploiting the deposit. A further distinction is made between the following two groups:

1. Development operations, which serve to make larger areas accessible. These are distinguished by a colon between the numeral and letter, for example, *13:b*.
2. Preparatory operations, which include all other incidental cuttings. These are designated by a numeral and lower-case letter; for example, *97a*.

(*b*) All other types of work are characterized by capital letters, as follows:

3. Winning-of-ore operations are indicated by capital letters; for example, *147N*. These operations comprise those that penetrate into and are not completely surrounded by the deposit, but which serve primarily for removal and exploitation of the ore. The distinction between secondary and winning operations will have to be determined individually for different mining methods, but it must then be rigidly maintained, because the value of reports is otherwise certain to suffer. How easily this distinction can be misused is evident in the instance of a mine which, to one of the officials, appeared to have too high a percentage of secondary operations. He simply began to enter certain types of operations as ore-winning operations and thus prevented all possible criticism, although conditions had changed not at all. Conversely, a decline in production for some reason or other can be accounted for by an increased count in the secondary operations, if there is no rigid distinction in force.
4. All other operations, such as buttressing, are characterized by a capital letter and a block number separated by a colon; for example, *28: P*.

The individual designation, therefore, in addition to indicating position, also reveals the classification of the operation in question; as a result, it facilitates the statistical work. The system is also convenient for typewriting purposes. To avoid phonetic ambiguity, the same letter

is not used more than once; that is, to have both a *28a* and *28A* is not permissible. If a block has more individual units than there are letters in the alphabet, a subscript numeral is employed; for example, $107H_1$. Should work be temporarily suspended in some unit, its designation may not then be transferred to some other place; on resumption of work in the unit, use of the designation is resumed.

Table I—Key for Designation Records

/	Stope under operation
≠	Stope in which work has been temporarily suspended
≠	Stope from which all ore has been removed
/	Drift under operation; the upper portion of this symbol is altered in the same manner as those for stoping to indicate the status of drifting.

Numbers that are in use, together with the appropriate descriptive marks, as listed in Table I, are recorded on the form shown in Fig. 2. Every working place retains its designation throughout the month, even though the boundaries of the block are passed within that period. At the end of the month a new designation is recorded on the form next to the old one. Under some conditions, too, a working place will retain its designation throughout the month, even though the type of work there changes; for example, if preparatory work develops into mining proper before the month is out, the designation would not be changed, as it would not be advisable to begin new records and a new payroll item. A unit extending into several blocks receives the number of the block in which the largest fraction of the unit is situated. If a block contains two mining units, the unit with the lower number receives the letters *a* to *m*, and the other unit *n* to *z*.

The system of designation is under the direction of a member of the geologic staff or a surveying official (but not a mining official), who confers daily with the mine superintendent at about the time the afternoon report is made. This centralization of the system guarantees its uniform maintenance. The system may also serve as a model for the designation of other features of a mine. These receive a letter, according to their nature and the number of the block in which they are situated; for example, chutes, *K*; storage shafts, *H*; and wood repositories, *D*. If a block contains more than one chute, these are identified by the use of a special small letter, for example, *K73a*.

Although the system has been applied only to mines with one horizontal working level, the same basic idea is applicable to mines having numerous levels. The usual designation would merely be preceded by a key to the level, such as *Fa*, *Fb*, or *Fc*. Thus, the working unit *H*, situated in block *107* of level *c* would be designated as *Fc 107 H*. On vertical or nearly vertical levels the rectangular blocks would be laid out vertically rather than horizontally. In mines where massive deposits are worked the designation might conveniently be based on a numeration of cubes.

Fig. 2—The form on which designations are recorded

	0	1	2	3	4	5	6	7	8	9
A										
B										
C										
D										
W										
X										
Y										
Z										

The progress of all mining operations is followed by a record of sketches, which describe the status of work at the beginning and middle of the month and indicate the completion date of single operations. These sketches are prepared in the mine with pencil on a durable quarto paper, cross-ruled in centimeters so that reductions will be 1 to 100 or 1 to 250. Subsequently, the sketches are redrawn with ink. The notation employed is shown on Figs. 3 and 4. An aluminum binder with a spring back is used underground to hold the sheets on which

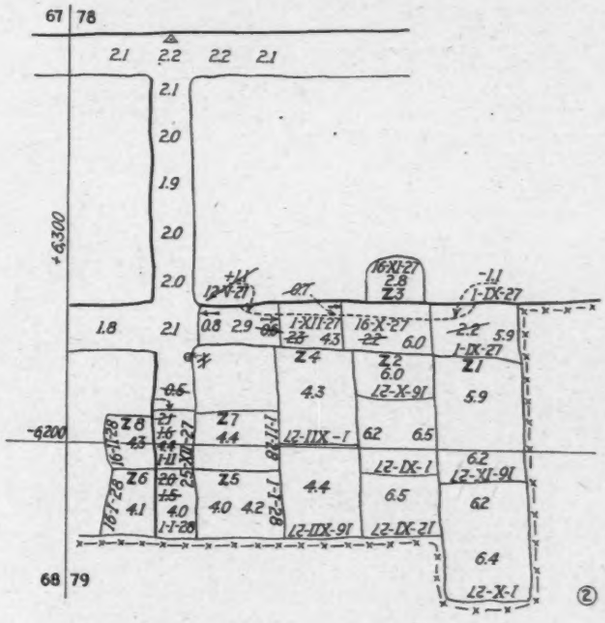


Fig. 3—Sketch showing a record of operations

the pencil sketches are made. The sketches are utilized as follows:

1. For the monthly revision of the progress maps maintained by the surveying staff. On the fourth of each month, a list of the units operating within the preceding month and the sketches with which to revise its maps are furnished the surveying staff.
2. For checking removal in special cases, such as following the rupture of supports in a working.
3. For checking exploitation as a whole. Ore remaining in an old mine can be accurately checked in this way.

A sketch sheet is prepared for each single unit before work is begun, and these sheets are preserved in the order of numbers and letters. Three folders, as follows, are used for filing the sketches:

1. A folder for work in progress, labeled "Current Sketches."
2. A folder for work temporarily suspended, labeled "Dormant Sketches."
3. A folder for work completed, labeled "Finished Sketches."

A sketch sheet is not used for more than one operating locality. To record the progress of a new unit on an old completed sketch is, however, permissible. When this

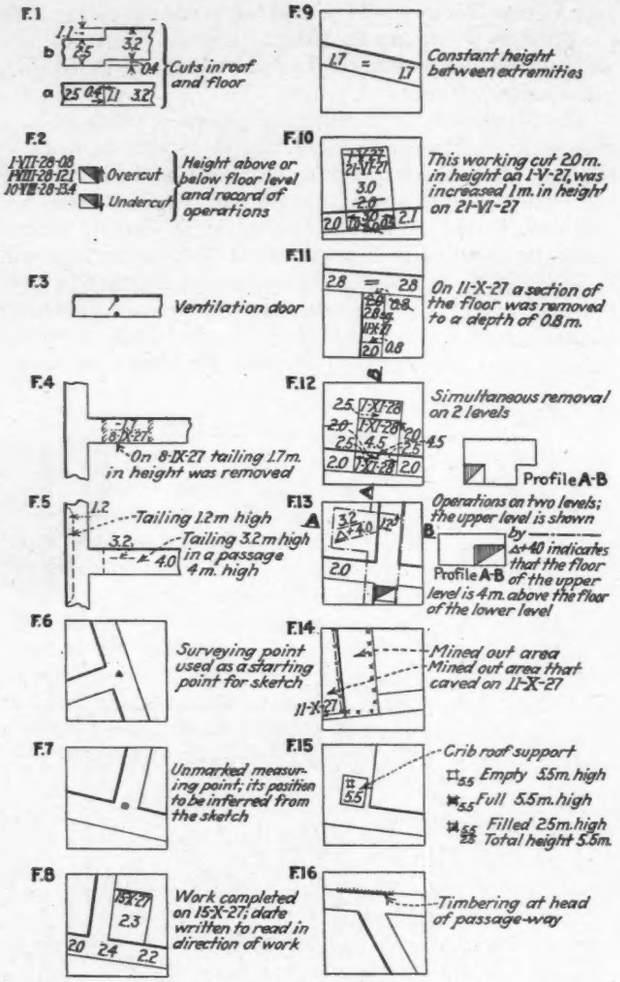

F.1
Cuts in roof and floor
F.2
Overcut
Undercut
Height above or below floor level and record of operations
F.3
Ventilation door
F.4
On 8-IX-27 tailing 1.7m. in height was removed
F.5
Tailing 1.2m high
Tailing 3.2m high in a passage 4m. high
F.6
Surveying point used as a starting point for sketch
F.7
Unmarked measuring point; its position to be inferred from the sketch
F.8
Work completed on 15-X-27; date written to read in direction of work
F.9
Constant height between extremities
F.10
This working cut 2.0m. in height on 1-V-27, was increased 1m. in height on 21-VI-27
F.11
On 11-X-27 a section of the floor was removed to a depth of 0.8m.
F.12
Simultaneous removal on 2 levels
On 8-IX-27 tailing 1.7m. in height was removed
Profile A-B
F.13
Operations on two levels; the upper level is shown by
Δ+40 indicates that the floor of the upper level is 4m. above the floor of the lower level
Profile A-B
F.14
Mined out area
Mined out area that caved on 11-X-27
F.15
Crib roof support
Empty 5.5m. high
Full 5.5m. high
Filled 2.5m. high
Total height 5.5m.
F.16
Timbering at head of passage-way

Fig. 4—Key to the sketching system employed

is done the record must show clearly which work belongs to a definite designation. The old designation should carry the date of completion in parenthesis; for example, *(98A-19.V.28)*; the number of the new unit appears beneath this designation. If two or more levels of a pit are worked, separate sheets, to indicate the operations on the various levels, are advisable. The use of check-points will make possible correct correlation of the sheets. Furthermore, two or more sketches of the same locality are made if contraction of a seam changes original dimensions. In such instances, encircled consecutive numbers are placed in the lower right-corner of the sheet, as shown in Fig. 3. The co-ordinate axes in red ink appear on every sketch, preferably coinciding with the block boundaries; the block numbers are inserted next to the axes in red ink in large characters. Inscriptions on a sketch read from left to right; only the date of starting an operation appears under the boundary line and normal to the direction of progress. The direction of North is at the top of the sketch, as in most maps, and is indicated by a heavy arrow. Individual working sections of a block are numbered in consecutive order. In recording, months are indicated by roman numerals to avoid confusion with height notations.

The following remarks apply to the sketches shown in Fig. 4:

Sketch F 9: In general the height of tunnels should be measured every 2 m. If the height does not vary for long distances, however, an equality mark may be used between the limits of such distances to indicate uniform height.

Sketch F 10: If the roof is re-cut, the former height is crossed out and a new one written beside it.

Sketch F 11: If the floor is re-cut, this is indicated by *sg* placed next to the new height.

Sketches F 12 and F 13: In some instances a plan should be supplemented by a profile.

Similar sketching practices have been in use in various mines for some time (cf., for example, *Mining & Metallurgy*, Jan., 1927, p. 16). The general features of the method discussed here were introduced by G. C. Heikes, and then developed by the author to suit special prevailing conditions.

Building a Town in Queensland for Mount Isa's Employees

THE company's town at the Mount Isa lead-zinc property, in northern Queensland, Australia, will be known as Isa Mines, according to the progress report recently issued by Mining Trust, which controls the property. Isa Mines is situated in a long, narrow valley. A low range of hills separates the town from the mill and smelter, now under construction. At the same time, the town has been planned so that men can reach their work from home in from five to ten minutes of walking. In the same valley, near the town, are the main office and the large new shaft for men and supplies, which will be the main entrance to the mine. There is a central park, around which are grouped the co-operative store, clubhouse, mess houses, dormitories, and residences.

To date, 48 detached cottages have been built for married workmen, sleeping quarters and mess for single men in the staff have been provided, as well as three dormitories for single men, eight houses for married officials, ten temporary dormitories for single men, and a general mess hall. Under construction are a butcher's shop and ice plant, 37 additional cottages for married workmen, a clubhouse, quarters for cooks and waitresses, twelve staff houses, and 50 small cottages. The cottages and dormitories occupied by employees will return an economic rental.

At present the domestic supply of water is 30,000 gal. a day from the company's bore north of the town site. Another bore near this one has developed a similar flow, and good water has also been found south of the town. Thus an ample supply of pure water for domestic purposes is assured. In addition 400,000 gal. daily is being produced from three shafts. About 36,000 ft. of the pipe line from the Rifle Creek dam has been laid and the remaining work is being continued rapidly. The company is now confident not only of having sufficient water for its needs but also a surplus that will permit irrigating gardens and laying the dust on the roads, thus adding to the "amenities" of the camp. About 1,200 men are now on the company payroll at Mount Isa.

The property, discovered in 1923, is about 600 miles west of Townsville, a port on the Pacific Ocean. To afford transportation, a railroad was built to Mount Isa from Duchess, 54 miles away, by the Queensland government. This railroad was completed last May and regular transportation to Townsville is now available. About $10,000,000 will have been spent before production is started some time next year.

Corrosion of Rabbles in Zinc Roasting Furnaces

WORK that was recently carried out on the Barrier roasting furnaces at the Electrolytic Zinc Company's plant at Port Pirie, South Australia, indicates that, as a structural material for rabbles, alloys high in chromium, but containing no nickel, are superior to chrome-nickel, inasmuch as corrosion is much less under the conditions of operation that obtain at that plant. The experimental work is described in detail in a paper recently prepared for the Australasian Institute of Mining and Metallurgy by J. Neill Greenwood and A. J. Roennfeldt, and entitled "The Corrosion of Rabbles in Zinc Concentrate Roasting Furnaces."

The roasting section at Port Pirie, according to an article in a recent number of *The Mining Review*, consists of two Skinner furnaces and six of a special type of Barrier roasting furnaces. The Skinners are cylindrical multiple-hearth furnaces, 20 ft. inside diameter, and with eight hearths. Their capacity is about 50 tons per day of zinc concentrate containing about 46 per cent zinc, 5 per cent lead, and 31 per cent sulphur. The fuel consumption is about 2½ tons per day, and the gases produced contain about 5 per cent of sulphur dioxide.

The Barrier roasters, of a type developed by Electrolytic Zinc, are circular furnaces 13 ft. in diameter, with six hearths. Each alternate hearth is made to rotate, and the ore, in passing from the top to the bottom, is rabbled alternately outward on one hearth and inward on the next by the plow-like action of replaceable teeth projecting from the under part of the hearth above. Sufficient heat is supplied by the combustion of the sulphur, so that no fuel is used. The capacity of each furnace is about ten to twelve tons per day, and the gases average about 6 per cent sulphur dioxide.

Where zinc ores are used in the manufacture of sulphuric acid, the evidence is in favor of the use of a number of the smaller units of the Barrier type rather than larger furnaces of the Skinner or similar types. Operations can be more closely controlled, and in the event of furnace trouble there is less interference with the tenor of the gas or its supply to the acid section.

Several improvements have been made in the Barrier furnaces as first used, among these being improved rabbles, which are the subject of the paper mentioned. The alloy that has been found to give the best service consists of carbon, 1½ to 3 per cent; chromium, 26 to 27 per cent; and silicon, ½ to 1 per cent. The life of the teeth was found to increase as the carbon content decreased, so the alloy with the lowest carbon content was used to combat the most drastic conditions. Temperatures may reach 1,000 deg. C., and the teeth are imbedded in a zinc concentrate which, at the time this work was carried out, contained 6 per cent lead sulphide. At or near that temperature, lead sulphide is appreciably volatile, and the rabble, being slightly cooler than the concentrate, condenses a certain amount of the galena on its surface, which is the main cause of corrosion. Oxygen is practically absent in the furnace atmosphere where the temperatures are highest, so that oxidation is not a factor in the corrosion; the alloy mentioned corrodes only slightly even when exposed to a free supply of air.

Corrosion takes place chiefly along a so-called wash line, where the surface of the bed of concentrates rubs against the rabble; the part of the rabble embedded in the concentrate is scarcely affected at all, nor is that portion badly corroded that is exposed only to the gases. As to the mechanics of the action, it was concluded that the corrosion is caused by the opening up of the surface of the steel by sulphide attack, removing the carbides, followed by oxidation of the scale along the wash line, with subsequent rapid attack, by this scale, of the metallic portion of the steel.

In the experimental work to find out what material would best withstand corrosion from zinc concentrates of the composition and at the temperature mentioned, nine alloys were used, of the following composition:

Table I—Analysis of Alloys

	Per Cent				
	Cr	Ni	C	Si	Fe
Mason & Cox high-carbon chromium steel	27.0	....	3.0	...	....
M. & C. medium-carbon chromium steel	27.0	....	2.4	...	....
M. & C. low-carbon chromium steel	27.0	....	1.5	...	....
Fahrite Ni	19.2	39.7	0.6	0.8	40.5
Fahrite CS	25.5	1.4	0.6	0.7	71.5
Thermalloy	28.4	58.2	1.0	0.8	11.7
Hybnickel	21.8	25.0	1.0	0.7	50.8
Fahralloy I	17.5	33.8	0.9	1.1	45.6
Fahralloy II	26.3	1.6	1.7	0.4	68.8

The six alloys mentioned last in the accompanying table were secured from America as the result of inquiries for alloys highly resistant to corrosion at high temperatures and which, at the same time, had good rigidity at temperatures over 850 deg. C. The following is a précis of the information concerning these:

Fahrite Ni—This alloy will withstand oxidation at all temperatures up to its melting point, 1,540 deg. C., and should give satisfactory service up to 1,100 deg. C. It can be used in oxidizing or reducing atmospheres, but *not in gases containing more than 2.5 per cent sulphur.*

Fahrite CS—This alloy is specially adapted for furnaces where there is a high percentage of sulphur in the gases. It can be used for temperatures up to 1,100 deg. C., though its rigidity is not equal to that of Fahrite Ni.

Thermalloy—An alloy used in Wedge roasting furnaces in several American plants.

Hybnickel—This can be loaded safely to 5,000 lb. per square inch fiber stress at 850 deg. C.

Fahralloy I and II—The No. II grade is specially recommended for rabble arms and teeth, and is said to be in use at several American plants.

In one series of tests, an attempt was made to find out how far sulphide corrosion penetrated after 24 hours' heating in zinc concentrates at 1,050 deg. C. The results, with a somewhat arbitrary procedure in determining penetration, are given in the first column of data on the following page. The last six columns give the results when the temperature was maintained at 900 deg.

The most important conclusion to be drawn from the accompanying data in Table II is the great reduction in corrosion resistance brought about by the introduction of high percentages of nickel into the high-chromium alloy. In concluding their paper, Messrs. Greenwood and Roennfeldt express the opinion that the corrosive action from a practical point of view is due to the presence of galena in the zinc concentrates, and that any improvement in ore-dressing practice which lowers the lead content will automatically be reflected in a longer life of the rabbles.

Table II—Corrosion Data

Alloy	Twenty-four-Hour Test at 1,050 Deg. Penetration, mm.	48-Hour Test at 900 Deg. Loss of Weight Penetration, mm.	Total Per Cent	Loss per Square Inch Grams	96-Hour Test at 900 Deg. Loss of Weight Penetration, mm.	Total Per Cent	Loss per Square Inch, Grams
M. and C.,H.C.....	0.32	0.13	1.5	.....	0.35	3.1	.....
M. and C.,M.C.....	0.36	0.16	2.1	0.92	0.36	4.0	2.5
M and C.,L.C.....	0.48	0.21	1.4	1.08	0.35	2.3	1.65
Fahrite Ni.....	0.60	0.35	20.1	18.2	1.10	31.8	17.5
Fahrite CS.....	0.39	0.15	2.1	1.5	0.32	4.1	2.7
Thermalloy.....	0.72	0.70	20.2	21.5	....	40.0	35.2
Hybnickel.....	0.75	0.18	21.5	13.6	1.20	43.2	29.8
Fahralloy I.....	0.96	0.28	5.1	3.1	0.90	....	.....
Fahralloy II.....	0.60	0.12	Increase due to adherent scale		0.43	1.8	1.5

Geological Survey Made of Helena District

A STUDY of mining districts in the region surrounding Helena, Mont., begun by the U. S. Geological Survey in 1926, has been continued. The Department of the Interior has issued a preliminary statement describing the area between York and Confederate Gulch, east of Helena, pending a detailed report on the whole region.

The area, comprising a stretch 20 miles long by 6 miles wide on the western slope of the Belt Mountains, has been richly productive of gold. Confederate Gulch was a center of the rush of 1864-1870; it is estimated that $17,500,000 of gold has been taken from the placer workings. Gold remains in the poorer and less accessible parts of the gulches, and placer mining is still carried on, although it can have no great future. Gold-bearing lodes were discovered soon after placer mining began. Lode mining, producing gold estimated up to $800,000, has been carried on at scattered times and places.

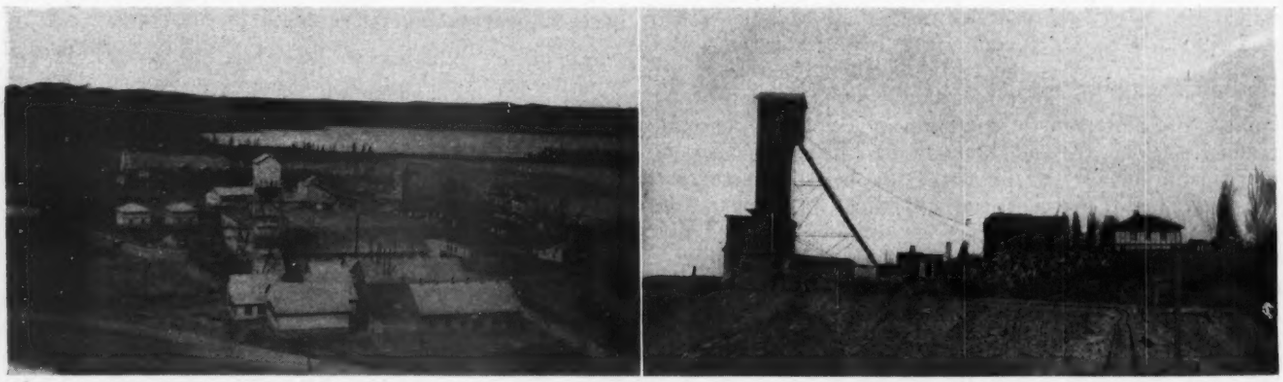
The area is occupied mostly by ridges or lateral spurs, of which the rocks in view are chiefly resistant limestone and quartzite of paleozoic age. Back of these are older rocks, of slaty and shaly nature, belonging to the Algonkian Belt series. Erosion has taken place over a long period, interrupted by lateral shifts. Terraces thus formed include the "bars" that have yielded much of the placer gold. Igneous rocks in the region consist mostly of dikes, of a dark greenish-gray quartz diorite, breaking through the shales. There are also two small quartz diorite stocks, of a granite-like appearance.

Gold-bearing lodes are of two kinds—small quartz veins, found in the diorite dikes and stocks and the adjoining shale, and large low-grade mineralized shear zones in diorite. The rich veins become lean at depths of 50 to 100 ft., probably due to a surface downward enrichment during erosion. Many small veins contain ore of workable grade, but are too narrow to be profitable to any great depth. The future of gold-mining in this district depends chiefly on the development of the shear zones. Lodes of this type are less resistant to weathering than the diorite; hence outcrops of potentially workable orebodies may be low and covered with a surface mantle. Although low-grade, the exposures of some of the known bodies are favorable to cheap mining.

Copper is also found in the region, in a belt lying 2 or 3 miles back of the mountain front. The lodes are of moderate width and are rather persistent. They are composed of quartz and ankerite; the ore mineral is chalcopyrite. Only one lode, the Argo, is developed extensively. Between 1902 and 1917 it produced about 3,000,000 lb. of copper. The other lodes doubtless contain similar undiscovered bodies. Costs reported by the operators of the Argo mine, however, indicate that such deposits cannot profitably be worked when the price of copper is below 20c. a pound.

At the Teck Hughes mine, in the Kirkland Lake district,

where preparations are now being made for an ambitious depth exploration scheme. At the left is the central mine shaft and the mill. At the right is the new south shaft, which has already reached a depth of almost 2,000 ft., and which will be connected with the central shaft at 3,000 ft.



Geology of the Sherritt Gordon Mine

DR. E. L. BRUCE
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THE rocks at the Sherritt Gordon mine, in northern Manitoba, consist of a series of sediments intruded by granite. The sediments are metamorphosed so that they are now gneisses. Some of the highly quartzose bands are quartzites, but commonly considerable mica is present, and these light colored or acid types are quartz-biotite gneisses. Interbanded with the light-colored gneisses are dark-colored basic rocks consisting chiefly of actinolite with some biotite and quartz. Garnet may be present in both types and is abundant in many of the basic varieties. The granites, with accompanying pegmatites, are later than the gneisses and intrude the sediments as sills or irregular masses.

The sulphides occur as elongated lenticular bodies of solid and disseminated character replacing the acid gneiss and to some extent the pegmatites. No ore occurs in the basic hanging wall. The ore horizon is from a foot or so to ten feet from the basic hanging wall and occurs in a rather thin-bedded horizon of the acid gneisses. In places, as in the western end of the second level from the west shaft, tongues of sulphides two or three feet thick project out from the main mass toward, but never into, the hanging-wall basic gneiss.

On the major drag fold, minor drags have been superimposed. The beds tended to open up along these minor crumples, and hence oreshoots can be expected at those places. Such lenses will extend for various distances down the limbs, but finally will pinch out down the dip. The discontinuity of the vein along the surface for part of the distance between the east and west shafts is probably due to this pinching out where the beds have not crumpled. The minor fold exposed in the vein between the first and second levels of the west shaft may be expected at a point 3,500 ft. east of the west shaft to be at a vertical depth of 1,100 to 1,200 ft., and the beds at that point will correspond in attitude to those penetrated in the crosscut from the west shaft to the ore zone. However, these minor drags will play out along their axes and other drags at slightly different positions will appear.

As mentioned in the foregoing, the thin-bedded acid gneiss which lies close to the hanging-wall basic gneiss is the favorable zone for the ore. This is evidently because, during the folding, larger and more numerous openings were formed there as the beds buckled. There is the further physical characteristic that the rock is brittle and held fractures. So far as the type of rock is concerned the rocks which contain a considerable quantity of feldspar and biotite as well as quartz seem to have been more easily and completely replaceable than the purer quartzose varieties.

Since the ore is never in the basic hanging wall, this dark-colored actinolite, quartz, garnet, or biotite-quartz-garnet rock has no direct effect, but it no doubt is indirectly responsible for the opening of fissures in the footwall gneiss. The hanging-wall gneiss shows indistinct bedding planes and seems to have recrystallized completely. It probably flowed under the pressures generated during folding and thus stresses accumulated in the more brittle acid gneiss in contact with it. Hence the fractures. If such is the case, the acid band lying to the northeast of the hanging-wall gneiss has possibilities as an ore zone, provided that other necessary physical conditions are present at any point. This is shown to be possible by the occurrence of some sulphides, including chalcopyrite, at the shaft on the Wiltsey-Henderson properties. This shaft is thought to be in the band corresponding to the basic band 800 ft. northeast of the west shaft of the Sherritt Gordon, and hence to the northeast of the Sherritt Gordon ore zone.

The granite is probably the source of the ore, but ore will not occur in it nor will ore be found close to it. Pyrrhotite may continue down the ore zones practically to the contact, but the content of copper will diminish as the granite is approached and positions of higher temperatures during intrusion are reached. That is, proceeding upward from the granite along the ore horizon, the lower part of the vein zone will consist of pyrrhotite with no copper. Copper will begin to appear higher up. It will reach a maximum at a certain level above the granite and then will decrease at still higher levels.

The granite has been intruded largely as sills, but there must be some level at depth at which the sills coalesce into the main batholith. Hence one must assume that tongues of granite like those shown southwest of Sherlett Lake may crosscut the formations and put an end to the downward extension of the ore zone. Further, these tongues may prevent the replacement of pyrrhotite by copper for a distance upward along the beds roughly proportional to the size of the granite mass.

Evidently, the pegmatites are older than the period of copper mineralization. It is possible that they are approximately of the same age or even later than the pyrrhotite introduction. The pegmatites disturb the veins to some extent and hence affect their regularity. In the hand specimen they appear lean, since the total amount of sulphides is less for the reason just mentioned, but since the lean mineralization is largely chalcopyrite the assay values of the ore may be nearly if not quite as high as those of the solid sulphides. The presence of abundant pegmatites raises the question of the proximity of the granite of which they are offshoots.

It follows from the foregoing that exploration may be expected to find ore in the following places:

1. Other shoots along the northwest continuation of the basic hanging wall and acidic footwall beyond the shoot at the main shaft of the Ook claim.

2. Oreshoots at depth on the continuation of the plunging minor folds that appear in the west shaft. Should such be found the deposit would bridge the zone where now no ore has been proved between the east and west shafts. Provided this favorable structure continues, it would lie on the Red claim at a vertical depth of 1,100 to 1,200 ft. at a point 1,100 ft. north of the south boundary of the claim. If a drill hole were projected to cut it normal to the zone, it would have to be placed 2,200 ft. north of the south boundary of the Red or near the center of the Green M-C., and would be about 1,700 ft. long. Invasion of granite from beneath is the chief unfavorable condition to be feared.

3. Ore lenses around the nose of the fold to the east of the east shaft. Structurally this seems probable, since the folding would tend to open spaces along the axis of the fold. The unfavorable features are:

(*a*) The possible intrusion of granite along the axis.

(*b*) The thinning of the basic gneiss which forms the hanging wall at the west shaft and the footwall at the east. A thinner member may not have accumulated stresses sufficient to produce fractures in the acid wall in which the ore occurs.

There seems no reason that the ore zone should not occur along the fold to the north as far as the condition of interbanding of acid and basic gneisses extends.

4. Lenses of ore may possibly be developed at certain places in other bands of acid gneiss. The prominent band lying next north of the basic hanging-wall gneiss is the most likely of these.

In the order of probability, the first, second, and third of these possibilities seem most promising. The third can be tested by short drill holes east of the east shaft owing to the flat dip of the beds on the nose of the plunging fold. The second suggestion requires deep drilling, but the determination of ore in that locality would add considerably to the ore reserves and would indicate continuation of shoots in the eastern part of the property.

In all occurrences the favorable horizon is close to the basic gneiss that has been termed the hanging-wall gneiss, and the location of that band is essential in placing drill holes.

From the annual report of Sherritt Gordon Mines.

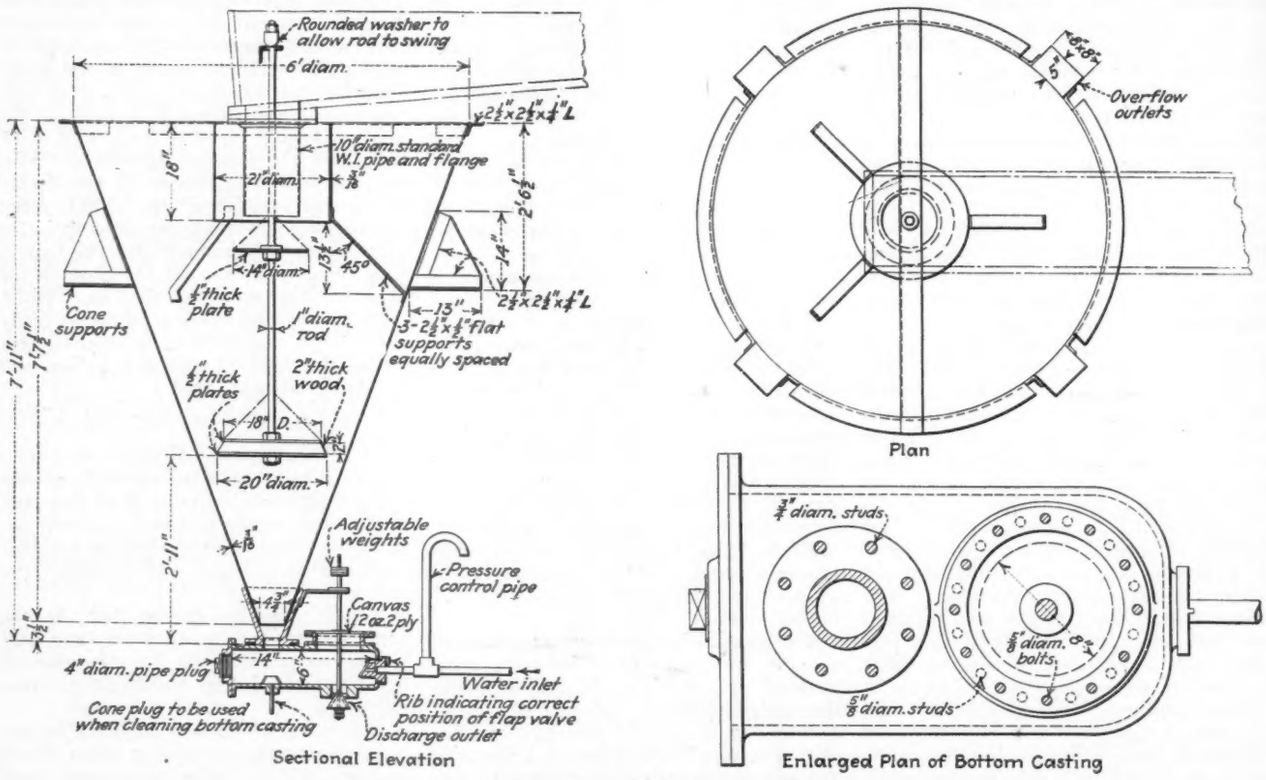
USEFUL OPERATING IDEAS

Dowsett Classifying or Dewatering Cone

THE drawing of the automatic-control cone shown on p. 845 of the issue of May 25 is not in accordance with the installation made at Dome Mines, writes C. W. Dowsett, now with Bwana M'Kubwa Copper, in Northern Rhodesia. One important detail has been omitted, and another is shown as it was designed at first and not as it was altered, prior to making the installation.

The first omission is in the water valve box exceeds the water-service pressure. The detail that was altered is the diaphragm shown about two-thirds down the inside of the cone. The diaphragm shown in the drawing published in the aforesaid issue is the Caldecott diaphragm, which is stationary, whereas the one introduced at Dome Mines is capable of being moved horizontally by the action of the sand moving toward the discharge of the cone. Details of the water service and swinging diaphragm are shown in the accompanying sketches.

Action of the diaphragm will be considered first. The diaphragm is hung by a rod supported from a bar across the top of the launder that is exactly over the center of the cone. The deflector plate, which, in the drawing previously published, was attached below the 10-in. inlet pipe, is shown in the accompanying sketches as being attached to the rod supporting the diaphragm. Also, as may be noted, the diaphragm, instead of being a disk plate, has an appreciable thickness and is a truncated cone. The cone is arranged for a discharge containing the minimum amount of water. The settled sand, in passing the diaphragm, exerts a considerable lateral pressure on it, owing to the slope of the cone. In nearly all cones the underflow of which is thick, a tendency prevails for more of the sand to discharge from one side than from another; this results in the settled sand inside the cone being too high in one part and too low in another. To correct this tendency, and to prevent "cratering," the Caldecott diaphragm was not utilized. The Caldecott diaphragm does tend to prevent cratering, but cratering can be totally eliminated only by an



Details of the Dowsett classifying or dewatering cone

service. The head of the water service must not exceed a certain figure; otherwise the pressure on the diaphragm will be so great as not to allow the valve to open again after it has closed. Maintenance of a constant water pressure is effected by carrying a branch of the water service, just before it enters the valve box, up vertically to a point approximately between one-quarter and one-third the height of the cone. On the end of the water service, inside the valve box, is a weighted clack valve, which prevents the sand in the valve box from backing up into the water service and choking it when the pressure in the

At Dome Mines, the cone was used as a means of distributing a sandy overflow to the concentrating cones, but at the same time it discharged from its lower outlet coarse oversize that would have choked the discharge nozzles of the concentrating cones. The first cones of this description that were installed at Dome Mines were used for desliming the sand before it was charged into the leaching tanks. When all-sliming was adopted, use of the cones was discontinued. As the operation of the cone is somewhat more involved than it ap-

automatic discharge-closing apparatus. The Caldecott diaphragm does not prevent excessive local flow.

To return to the truncated cone diaphragm—the lateral pressure on the diaphragm will depend upon two factors: First, the speed of the passing settled sand; and, second, the density of the sand. The latter seems to be the dominating factor. When the sand starts to be drawn too quickly from one side of the cone, the density at that place falls off, with the result that the diaphragm is pushed over into the low-density stream. This movement of the diaphragm impedes the flow of the stream, and at the same time also induces a freer flow from the other side of the cone, which will logically be somewhat congested.

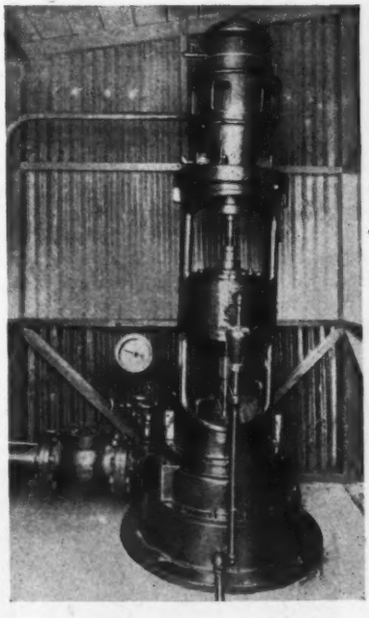
The sand flow through the lower orifice of the cone is retarded by the crowding effect of the converging sides and also by the change of direction in the valve box. Passage of the sand through the discharge valve would result in considerable resistance but for the fact that the water service admits a trickle of water near this point. This "lubricates" the passage of the sand, so that, when the flow is normal or less than normal, the pressure in the valve box is insufficient to raise the canvas diaphragm and close the discharge valve.

The discharge valve has a capacity such that, if kept open all the time, the settled sand would be discharged quicker than it accumulates in the cone. In discharging, the volume of the discharge increases as the level of the settled sand in the cone falls. This condition is the result of two things: First, the moisture content has risen in the settled sand, owing to its having been a shorter time settling in the cone; and, second, because the real head of the mixture of settling and settled sand is being more truly registered on the discharge of the cone. The settled sand does not register its true head at the discharge, because its high internal friction causes it to be appreciably supported by the converging sides of the cone.

When the pressure in the valve box becomes greater than that of the incoming water, the clack valve on the water service closes, causing the volume of the sand flow to decrease as a result of increased resistance at the discharge valve. Should the pressure continue to increase, the pressure on the canvas diaphragm becomes sufficient to start lifting the valve stem, thereby partly closing the valve. Should the discharge still gain on the settled sand in the cone, the valve will suddenly close entirely. The result of the sudden stoppage of a large flow of sand is a considerable jar to the cone, and this causes the settled sand to level itself in the cone, bringing down any fine sand that has worked up the side of the cone. After being closed for about 15 sec., the valve reopens and flow of the sand starts, slowly at first, but quickly gathering volume as the water valve opens.

Only a release of the pressure on the canvas diaphragm will permit the valve to reopen. The settled sand in the cone is consolidated by the jar of the sudden closing of the valve again, when thickened sand, which has been in movement, is stopped. This immediately offers an increased resistance to further movement, and results in the weight being largely supported by the sides of the cone, leaving relatively less weight to register at the apex. The pressure in the valve box is relieved by the leakage of a small quantity of water, which takes place bteween the iron surface of the valve and its iron seat.

The Dowsett cone will operate without attention for a month or more. If the amount of sand sent to it is increased, it simply closes less often. To obviate the necessity of running out the contents of the cone when the canvas diaphragm is renewed, the valve situated immediately under the apex of the cone is pushed up by means of a lever into the bottom of the cone and the sand flow cut off.



A Leaning Tower of Pisa among pumps

Laying Out Angles Without a Protractor

WHEN no protractor is at hand, angles can be laid out by the use of a square, a pair of dividers and a straight-edge, writes J. Staveley in *American Machinist*.

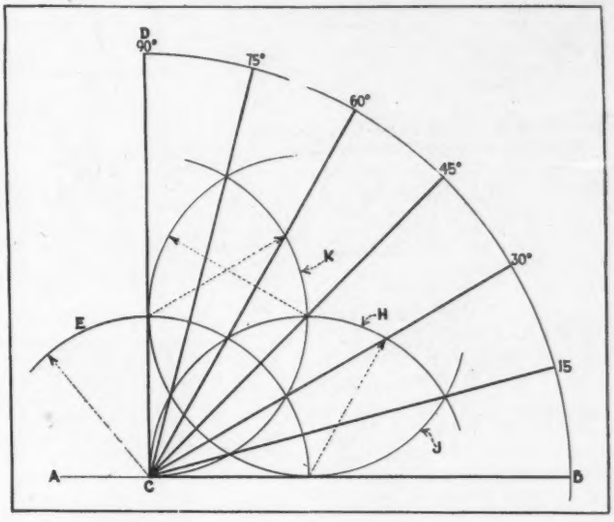
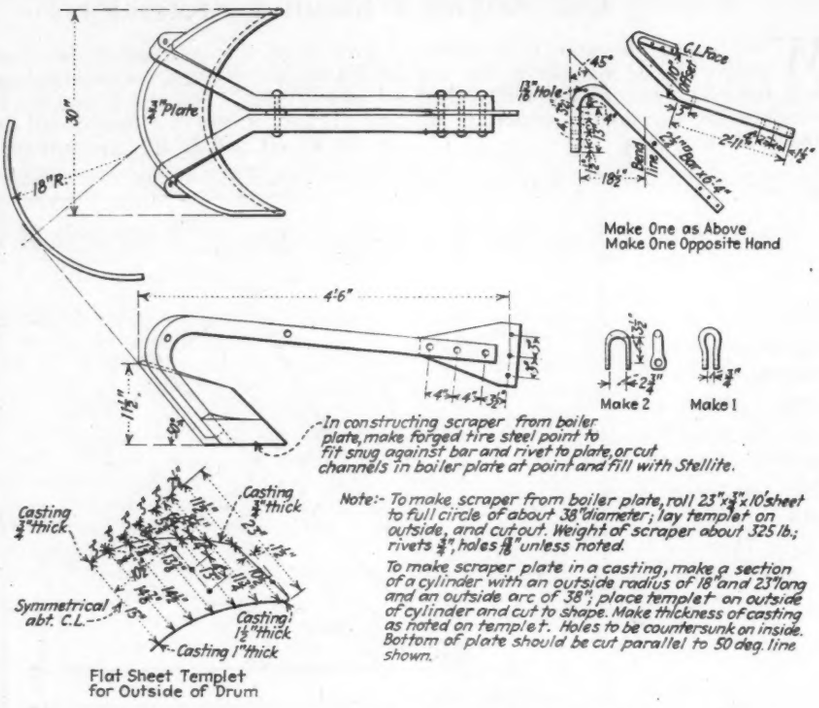


Diagram illustrating method employed in laying out angles with a square, pair of dividers, and a straight edge

Draw the horizontal line *A-B* and the perpendicular line *C-D*. With the dividers set to any convenient radius, draw the arcs *E*, *H*, *J*, and *K* from the centers shown in the illustration. Lines drawn from the intersection of lines *A-B* and *C-D*, through the intersections of arcs *H* and *J* (outer), *E* and *K*, *E* and *H*, and *H* and *J* (inner), will be 15, 30, 45, 60, and 75 deg., respectively, from the horizontal. The drawing of the perpendicular line forms an angle of 90 deg., automatically. Other and intermediate angles can be laid out by subdividing those already obtained.

Pumping from a Well That Is Out of Line

A DEEP-WELL pump will work in a well that is out of plumb. One such case where the well was out of line by more than 6 ft. in 100 ft. is reported by the *Worthington News* for September. This well, on the property of a food-product manufacturer in the South, was approximately 300 ft. deep and would furnish as much as 400 g.p.m. with a draw down to about 44 ft. from the surface. Nearly 300 g.p.m. was required for circulating water, and a pressure of 30 lb. was necessary to put the water through the plant. Upon advice of the Holyoke Works of the Worthington Pump & Machinery Corporation, a No. 6 Axiflo pump was installed in 1927. It


30"
¾" Plate
18" R.
Make One as Above
Make One Opposite Hand
4'6"
Make 2
Make 1
In constructing scraper from boiler plate, make forged tire steel point to fit snug against bar and rivet to plate, or cut channels in boiler plate at point and fill with Stellite.
Note:- To make scraper from boiler plate, roll 23"x¾"x10' sheet to full circle of about 38" diameter; lay templet on outside, and cut out. Weight of scraper about 325 lb.; rivets ¾", holes ⅞" unless noted.
To make scraper plate in a casting, make a section of a cylinder with an outside radius of 18" and 23" long and an outside arc of 38"; place templet on outside of cylinder and cut to shape. Make thickness of casting as noted on templet. Holes to be countersunk on inside. Bottom of plate should be cut parallel to 50 deg. line shown.
Casting ¾" thick
Casting ¾" thick
Symmetrical abt. C.L.
Casting 1½" thick
Casting 1" thick
Flat Sheet Templet for Outside of Drum

Details of new Crescent scraper designed by United Verde Copper Company and employed at the company's Jerome, Ariz., mine

was direct-connected to a 20-hp. motor to run at 1,800 r.p.m. Since then it has run 24 hours a day during the busy season, and has not been out of the well nor cost a cent for repairs.

Hand Car Saves Time Underground

WEARL GREENOUGH, of Mullan, Idaho, manager of Atlas Mining, has introduced something new in the Coeur d'Alene district, the purpose being to save time in going to and coming from distant underground mining operations. It is a diminutive hand car. The car used at the Atlas, shown in the picture, is built for use on an 18-in. gage track, but may be obtained from the manufacturer for any desired gage.

The Atlas crosscut is 7,000 ft. long. At 5,000 ft. from the portal a drift is being run east, which has now been advanced over 3,000 ft., making the present face about 9,000 ft. from the portal. Before the hand car was introduced 40 minutes was required to walk to the face, and about the same to come out. The hand car reduces the time to less than half going in, and less than a third coming out; in fact, the shift of four men often come out in ten or eleven minutes.

Mr. Greenough also has a velocipede for his own use. The hand car weighs about 400 lb. and the velocipede 98 lb. The pictures show Mr. Greenough, with Oscar Hershey, geologist, of San Francisco.

The underground hand car and velocipede described are manufactured by Light Inspection Tire Works, Hagarstown, Ind.

New Crescent Scraper Has Outstanding Advantages

A NEW SCRAPER, possessing exceptional digging ability, besides being readily and economically constructed at a mining property, has been designed by H. V. Kruse, chief mechanical engineer of the United Verde Copper Company, Jerome, Ariz. The device, known as the Crescent scraper, is actually two joined plows, one right hand and one left. The extent to which the plow points dig in can be controlled by a pull-cable fastening, although the angle of the points is such that they tend to lift out any rocks encountered, rather than to slide over them.

In making the scraper plates, a 23-in. x10-ft. steel sheet is rolled into a circular plate ¾ in. thick and from this three scraper plates are cut out with a torch. The plates are then rolled to an arc of 18-in. radius. Castings, as well as boiler plate, may be used in constructing the scraper blades. With boiler-plate construction, forged-tire steel points are fitted against the drawhead bars and riveted to the plate. As a substitute for this practice, channels are cut in the plate at the points and filled with Stellite. When a scraper plate is worn out, a new one is sent underground and replacement made without moving the scraper from the working face.

The drawhead bars are 2½ in. square and are riveted together with a ¾-in. drawhead plate between them. The scraper is 30 in. in width, has a digging angle of 50 deg., and weighs about 325 lb. Construction details of the scraper are shown in the accompanying sketches.

Dust Cap Protects Motor When Not in Use

OPERATION of an open-type motor in a small box built over it to keep out dirt is almost certain to cause injurious heating of the windings unless the load is very light. On equipment which is not used regularly it may be practicable to arrange a dust cover which can easily be raised or removed during actual use of the motor.

A direct-current motor mounted on a lathe in the repair shop at a West Virginia property is equipped with a removable cover of a unique pattern, according to *Coal Age*. This cover is in the form of a circular hood, like a stocking cap, which has the small end attached to the top of the motor. As illustrated, the fabric used is non-inflammable brattice cloth. The hood is lowered and raised by means of a rope attached to an iron ring, which forms the large end of the cap. The rope passes through a pulley overhead and then down to a hook located at convenient height on the wall. When the cap is raised it turns inside out.

Hand car and velocipede used in the Atlas mine. W. Earl Greenough, manager, on the velocipede; also Oscar Hershey, on the hand car.

Personal Notes

L. M. Cockerell has left England for California and Texas.

J. M. Callow has returned to New York City from London.

Edgar Rawson was a recent visitor at Miami, Ariz., on his way to New York from Mexico.

R. S. Dean, chief engineer of the metallurgical division of the U. S. Bureau of Mines, was in Salt Lake City recently.

George R. Sanders, formerly with Southwestern Engineering, has joined the staff of the Denver Equipment Company.

Oscar A. Glaeser, safety and ventilation engineer with United Verde Copper, has returned to Jerome, Ariz., after a three weeks' trip to Seattle, Wash.

E. W. Berry, formerly superintendent of the North Star mine, is engaged in designing and installing a flotation mill at the Goldstone mine, near Baker, Idaho.

C. A. Mitke has returned to the United States, via England. He addressed the Chicago section of the A.I.M.E. on Nov. 27, and is now in New York City.

J. V. N. Dorr sailed recently from Japan, on the "Empress of Canada," arriving in Seattle on Dec. 2. He expects to be in New York City by about the middle of December.

W. H. Eardley, assistant manager at Salt Lake City for U. S. Smelting, Refining & Mining, suffered a minor accident while underground recently, necessitating absence from duties for a few weeks.

Roland Blanchard, mining geologist, of San Francisco, and a staff of assistants sailed from San Francisco on Nov. 20, for Lawn Hills, Queensland, Australia, to examine the Lawn Hills Concession of Mining Trust.

C. H. McL. Burns has been appointed manager of the engineering department of the Dodge Manufacturing Company, of Toronto, Ont. Mr. Burns was in charge of the design of the materials-handling equipment for the new mill and smelter of International Nickel, at Copper Cliff, Ont.

W. B. Timm, Chief of the Division of Ore Dressing and Metallurgy, Mines Branch, Dominion Department of Mines, has returned to Ottawa from a trip to Western Canada and the United States, during which he visited plants in the Coeur d'Alene district of Idaho, and in British Columbia and Manitoba, Canada.

A. B. Winther, superintendent of Utah Consolidated Mining, at Bingham, from 1910 to 1923, has sailed from New York to assume the position of manager of mines for Bwana M'Kubwa Copper, in Northern Rhodesia. In recent years, Mr. Winther has been stationed at Cardin, Okla., as manager of Anna Beaver Mines.

William T. MacDonald, formerly mill superintendent at Nacozari, Sonora, Mexico, for the Moctezuma Copper Company, is now in charge of milling operations at Copper Cliff, Ont., Canada, for the International Nickel Company. After graduating from the Columbia School of Mines in 1908, Mr. MacDonald joined the staff of the Utah Copper Company, at Garfield, Utah, and

WILLIAM T. MACDONALD

remained there until 1911, at which time he was assistant mill superintendent. From 1911 until 1915 he was assistant superintendent and later superintendent of mills for the Chino Copper Company, at Hurley, N. M. From 1915 to 1921, he was with the Ray Consolidated Copper Company, at Hayden, Ariz., as assistant mill superintendent, and later as acting general superintendent. Mr. MacDonald has been mill superintendent at Nacozari since 1921.

R. W. Diamond and **E. M. Stiles,** respectively concentration superintendent and chief engineer for Consolidated Mining & Smelting, have left Trail, B. C., for Italy, there to study the methods used in the electrolytic production of hydrogen, which will be employed in the synthetic fertilizer plant now under construction at Warfield, B. C.

OBITUARY

Robert T. Huston, vice-president and superintendent of the Connorsville Blower Company, died at his home in Connorsville, Ind., on Nov. 14, after a short illness.

George G. Young died in Tucson, Ariz., on Nov. 14. He was associated with Col. J. C. Greenway in the development of the New Cornelia mine. Mr. Young was 63 years old.

Robert Lowe died at Moose Jaw, Sask., on Nov. 22, after a short illness. He was one of the pioneers of the Yukon Territory and made his fortune in copper-mining operations in the territory. Mr. Lowe, who was 60 years of age, also had the distinction of building the first bridge over the Yukon River.

James F. Robinson, of Miami, Okla., president of Commerce Mining & Royalty, and a director of the American Mining Congress and the American Zinc Institute, died at Denver, Colo., on Nov. 20, after a long illness. Mr. Robinson, in addition to his many other activities, published the *Miami Daily News-Record.*

F. W. Sperr, professor emeritus of civil and mining engineering at the Michigan College of Mining and Technology, at Houghton, died at his home in Houghton, on Nov. 19, after a brief illness. He had been head of the department for 32 years. Professor Sperr was well known as a mining authority, and was chairman of the mining methods committee of the A.I.M.E. for many years. Professor Sperr was 73 years of age. He is survived by his widow and five sons.

Sidney Elliott Bretherton died in Berkeley, Calif., on Oct. 4. He was a member of the A.I.M.E. since 1889. One of the "old guard" of smelter men, he began his career as assistant assayer at the Morgan smelter, Salt Lake City, Utah, in 1877. He was assayer at the Stockton smelter in 1878; assayer and chemist at La Plata smelter, Leadville, Colo., 1879-81; superintendent and manager, Bonanza smelter, Colorado, 1882; and general superintendent and metallurgist, American Smelting Works, Leadville, 1883-93. He then became a consulting engineer for the Afterthought Copper Company in 1905, and retired from this position in 1916 to become a consultant. He was 75 years old at the time of his death.

John Bolton Farish died on Nov. 14, at his home in San Francisco. Mr. Farish was born in San Francisco in 1854. He was educated at the City College of San Francisco. When about sixteen years of age, he went to work in the Sierra Butte mine, under his elder brother William, who was at that time manager of this property. After about a year, he returned to San Francisco to take up the study of assaying and geology. Later, William Farish went to Leadville, Colo., where John joined him in 1879, and established the first assay office in that camp. In 1883 he went to Denver, where he resided until his retirement in 1913. During his active professional career he examined and operated properties throughout the United States, Mexico, and Canada, and also in Russia, Hungary, and Japan. He maintained offices in Denver and New York, and at one time had offices also in Mexico City and London. He was actively interested in the affairs of many technical societies and civic organizations. Mr. Farish made many contributions to the Metropolitan Museum of Art and the American Museum of Natural History, in New York. He is survived by his widow and five sons.

COMMENT AND CRITICISM

Industrial Progress or Economic Chaos

To the Editor of "E.&M.J.":

Your editorial on the first page of your issue of Nov. 16, 1929, regarding the employment of American engineers in Russia under present conditions is one of the most extraordinary statements I have ever seen in a reputable technical or engineering publication. Whoever wrote this article evidently knows little of Russia and less of this composite but on the whole very likeable people. As is well known, the great mass of Russians are simple peasants now ruled by a small minority of half-educated and untrained city dwellers who call themselves the "Russian Soviet" and are probably the most corrupt, cruel band of cutthroats to be found in history.

The logic of your statement or argument seems to me as unworthy as illogical. In one breath you say the return of the properties belonging to the Russo-Asiatic company appears to be out of the question. In your following statement you say "one can well hope that the utilization of expert American experience and knowledge in the rehabilitation of the non-ferrous industries of the U.S.S.R. (whatever that might stand for) will hasten the day when the claims of Russo-Asiatic will be paid in full." It seems to me any decent engineer who engaged to undertake such work would feel, or ought to feel, like a receiver of stolen goods, which in most countries is considered a crime. On moral grounds it is difficult to see how you can justify such a hope, especially that American engineers will be thus employed in what you term the "vast industrial experiment now in progress" in Russia.

In my opinion these schemes are largely fantastic and will never be completed by the Soviet even if the money can be found, which is highly improbable. Assuming they can be completed, who is to operate them? Surely no one who knows Russians will believe they can do it. Moreover, their best brains and technical men and engineers are either murdered or driven from the country, and even in the old days they never were noted for their skill and efficiency, necessitating, in most cases, the supervision of foreigners.

There can be no question regarding the vast potential resources of Russia, but they cannot be developed without outside help, both financial and technical, a policy wholly at variance with the bolshevik creed. American engineers and equipment companies who do business with the Soviet without the most careful safeguards are simply foolish and deserve to be stung. Until the sanctity and right of private property is fully recognized in Russia, no healthy, successful development can be expected in that great country. The Russians are naturally a kindly, rather shiftless but very human people and will react just as readily as we do to the opportunity for favorable achievement when the results of their efforts will not be taken from them. Under present conditions this is not possible with the communistic regime.

I have not the pleasure of personal acquaintance with Mr. Leslie Urquhart, but I know him to be an honorable gentleman who has lived long in Russia and knows its people as few of us do. He ought to be backed up by every respectable engineer and engineering publication in America and the British Empire who does not believe in accepting or becoming the custodian of stolen goods.

I hope you will be good enough to publish this letter.

F. Lynwood Garrison.

Philadelphia, Pa.

Beryl Crystals 18 Ft. Long

To the Editor of "E.&M.J.":

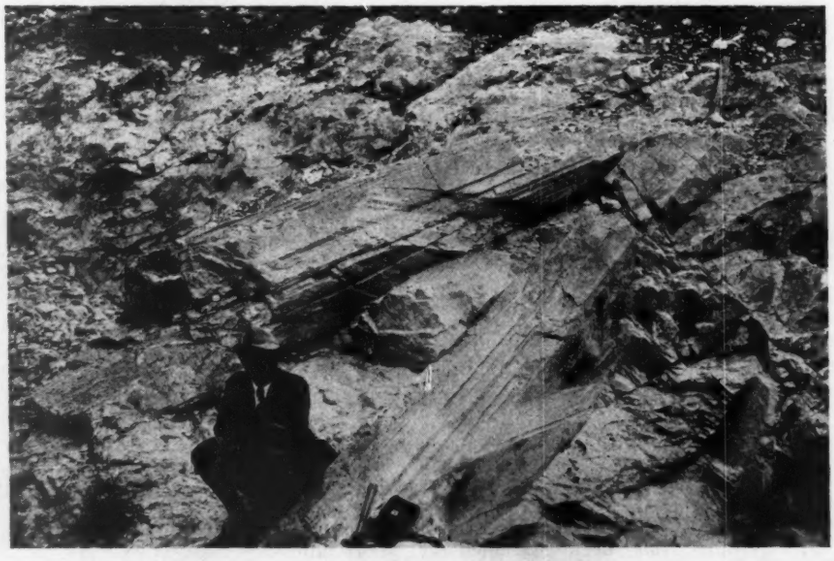
Reports in the technical press on progress made in the industrial uses of beryllium and in the production of the metal from its principal ore, the mineral beryl, lend interest to the known occurrences of beryl of possibly commercial value. Large deposits of beryl are rare, and in this connection the accompanying illustration of some enormous crystals of beryl found some months ago at the Bumpus feldspar quarry, near Bethel, in Albany Township, Me., may be of interest. These giant beryl crystals are probably the largest ever found, measuring as much as 18 ft. long and 4 ft. across. They were discovered almost at the outset of quarrying operations, within a few feet of the surface. Hugh S. Spence,

Mining Engineer,

Mineral Resources Division.

Ottawa, Ont.

Giant beryl crystals from a quarry near Bethel, Maine



Iron Contamination and Cyanide Consumption

To the Editor of "E.&M.J.":

Mr. E. M. Hamilton's article on the "Effect of Iron Contamination on Extraction and Cyanide Consumption After Super-Fine Grinding" in *Engineering and Mining Journal* of Aug. 10 at once attracted my attention as pointing the way to possible economies in the cyanide treatment of the silver-cobalt-nickel-arsenic concentrate at the Nipissing mine, a material requiring exceptionally fine grinding to secure a profitable extraction of the silver. Accordingly, a number of tests were run, the concentrate being ground in water in a 12 x 9½-in. porcelain jar mill with (a) 1-in. iron balls and (b) 1 to 1½-in. flint pebbles, and cyanided under conditions paralleling our mill practice as closely as possible.

Products of like fineness were obtained with the two grinding media by

Cyanide Tests on Nipissing Concentrate Ground With (A) Iron Balls and (B) Pebbles

Test No.	Dry Weight of Ore, Pounds	Assay, Oz. Ag	NaCN Consumption Pounds per Ton Ore	Extraction Per Cent	Grinding Data: Degree of Fineness	Per Cent	Grinding Conditions
1-A	19.96	Head 3251.0			+200	1.36	Ground with iron balls for 12 hours, removed slime and ground remainder for 12 hours.
		Tailing 236.9	56.5	93.5	—200 sand slime	4.03	
						94.61	
1-B	19.96	Head 3251.0			+200	0.19	Ground with flint pebbles for 24 hours, removed slime and ground remainder for 24 hours.
		Tailing 189.5	47.9	94.8	—200 sand slime	12.53	
						87.28	
2-A	20.06	Head 1106.2			+200	2.11	Ground with iron balls for 24 hours.
		Tailing 21.9	52.0	98.1	—200 sand slime	4.64	
						93.25	
2-B	20.06	Head 1106.2			+200	1.06	Ground with pebbles for 60 hours.
		Tailing 26.5	40.2	97.7	—200 sand slime	4.29	
						94.65	
3-A	17.82	Head 1031.1			+200	0.96	Ground with iron balls for 6 hours.
		Tailing 338.9	69.7	67.9	—200 sand slime	64.09	
						34.95	
3-B	18.05	Head 1031.1			+200	2.07	Ground with pebbles for 12 hours.
		Tailing 301.9	60.7	71.4	—200 sand slime	62.88	
						35.05	

adjustment of the grinding periods. An approximate comparison of the respective products was made by wet screening through 200 mesh, followed by agitation of the highly diluted minus-200-mesh pulp, settlement for a definite period, and decantation of the water with the finer particles still in suspension. In this way the material finer than 200 mesh was separated into two products, styled "minus-200-mesh sand" and "slime."

Stock solution from the "high-grade mill" circuit was used in all cyanide tests, made up to a strength of 14 lb. NaCN. No attempt was made to maintain a strength higher than 6 lb., below which point there is a possibility of silver reprecipitating. The duration of cyanide treatment was eighteen hours in Series 1 and twelve hours in Series 2 and 3.

The results of three series of tests, shown in the accompanying table, indicate that detrital iron accounts for an appreciable amount of the cyanide consumed in the treatment of concentrate of this type, though it has little effect on extraction.

JOHN M. CARTER

Cobalt, Ont., Canada

New England Tin Metallurgy

To the Editor of "E.&M.J.":

A recent happening in the course of some work we are doing might be of interest to you in that it shows the noble and exalted place held by the onion in metallurgical practice. The following is the tin recovery practice in one of the large rubber plants in the New England district:

"We melt pigs of tin, roll them into sheets, and use them on our combs in vulcanizers for 13 hours at 306 deg. F. and 55 lb. pressure. The tin is stripped from the comb and remelted. We remelt 2,000 lb. of tin three times a week, and to one of these three remelts we add 150 lb. of new tin to freshen up the mass. About once a month if we think the tin is getting too soft we add 2 lb. of bismuth. The temperature of the remelt is 600 to 650 deg. F. An onion is thrown into the pot and the tin is refined for an hour, bringing all our rubber overflow which has adhered to the tin to the top, where it is skimmed off. The molten tin is poured into blocks, allowed to cool, and goes back to the rolls."

C. L. MANTELL.

Brooklyn, N. Y.

Future of Northern Rhodesian Copper

To the Editor of "E.&M.J.":

I have read with great interest an article in *Engineering and Mining Journal* for Oct. 26, by Owen D. Letcher, your special Johannesburg correspondent. In the main this article, which is said to be quotations by myself, is accurate, but Mr. Letcher has made some errors in his statements. For instance, he quotes me as saying that "copper prices will be maintained at about their present level, even though Northern Rhodesia may be producing as much as 750,000 tons of copper annually within ten years." There is not the slightest possibility of Northern Rhodesia producing anything like this quantity of copper within that time; nor do I believe that the average price of copper for the next ten years will remain near the present level. And, further, I am not willing to go on record with any statements about the production of copper from Northern Rhodesia ten years hence, nor am I willing to hazard a guess at what the average copper price will be. I did tell Mr. Letcher that I believed that the production of copper from Northern Rhodesia during the next ten years would be absorbed by the world at a price sufficiently high to allow Northern Rhodesian mines to earn a fair margin of profit.

I note that Mr. Letcher heads his article "Director of Roan Antelope." I am not at this time, nor have I been at any time, a member of the board of this company. It would have taken only a little effort on the part of your correspondent to be put right on this point.

Mr. Letcher also quotes me as saying that the Roan Antelope power plant is virtually completed. This is again a serious error, for, while one unit of the power plant is running, construction on the major portion of the plant has just commenced.

Mr. Letcher called upon me to discuss certain business arrangements with his journal in South Africa, and at no time during the conversation did he intimate that he wished to publish the result of our general discussion on the future of Rhodesian copper. I have no objection to being quoted if my quotations are recorded accurately; but I think you will agree that it is not fair to take poetic license with the estimates of an engineer. Mr. Letcher could easily have stated that he wished to write an article for *Engineering and Mining Journal* and I would have been glad to go over it with him, to correct such inaccuracies as his proposed work might contain.

ARTHUR D. STORKE.

London, England.

Tri-State "Ore" Again

To the Editor of "E.&M.J.":

The word "ore," as used in the Tri-State district, applies to zinc and lead only *after* concentration. Prior to that it is "dirt" in soft ground and "rock" in hard or shooting ground. So it was in 1860, and so it is today, and may continue to doomsday, unless an abbreviation of concentrate or a short word is coined to replace it.

For almost three-quarters of a century this use of the word "ore" has prevailed, and it has, therefore, the weighty support of long time as defense of such usage.

JESSE A. ZOOK.

Joplin, Mo.

Consultation

Market Sought for Complex Concentrate

I have a problem in which you may help me, if you are able. Some six months ago I acquired a large area of tin-bearing ground, alluvial and reef. We commenced washing the alluvial soil in 6-ft. diamond washing pans. The resulting concentrate assayed 3.4 per cent columbium oxide, 29 per cent tantalum, and 49 per cent tin. Our difficulty is to find a firm who would buy our output, as we understand that great difficulty is experienced in getting these three minerals separated."

If any of our readers who are interested in the refining of a concentrate of this character will get in touch with the editorial department we will send their names to our correspondent.

How Sound?

"Everybody knows how sound business is," said a customer in Row B yesterday morning. "Howe Sound . . . 4½," said the broker, whose mind was on less theoretical matters.—F.P.A. in the New York *World.*

Mine Cars— Home-made and Others

BUILD or buy—this choice of alternatives often confronts the mining company that has a well-equipped shop. Facilities for manufacturing, when idle or partly utilized, furnish a strong incentive to attempt building some of the equipment previously purchased. Not unnaturally, those responsible may think that this will be more advantageous than buying. The company will get the big (?) profit that has been going to the equipment manufacturer and will be able, besides, to make things exactly as desired, by incorporating various bright ideas that someone or other around the works has had from time to time. Such a course, moreover, it may seem, will serve to keep the shop force busy and prevent lay-offs, with the loss of skilled workmen, who may possibly be badly needed again at some near-by date. The temptation may indeed be strong at such times to build instead of buying, and under certain circumstances the reason for doing so may be sound.

Especially is this true where small and simple castings are required. The advantages that accrue to a mining company from having its own foundry or melting furnace have been pointed out in previous issues. They are most pronounced where the plant is isolated, freight rates are heavy, and considerable scrap is available. Many castings, however, call for more skill than the average mining company has at its disposal. Good mine car wheels and bumpers are no exception.

Opinion Balanced

In general, the advisability of building anything instead of buying it may be said to vary inversely as the amount of designing and manufacturing skill required to produce it. Of all the equipment used about a mine, the ore car seems most often to incite the operator with the desire to enter the manufacturing business. Perhaps it is because the work of fabrication seems a relatively simple matter. Whatever be the reason, eleven out of twenty representative mining companies interviewed in various parts of the United States are building their own cars in whole or part. Thus the opinion for and against such practice appears to be roughly balanced. And the possession of shop facilities does not seem to be the deciding factor. Some of the companies that buy are as well equipped in this respect as those that build. Evidently the former see an advantage in buying from the manufacturer. A review of the practice of those in both groups may bring out points of interest.

One of the companies that builds its cars, an independent iron-mining operator in the South, with over 300 cars in service, buys the assembled trucks and makes the bodies and erects the cars in its own shops. On the average, this operator finds it necessary to replace one car a month. Another iron-ore operator, in the Lake Superior region, uses 200 cars, and to maintain this stock builds six per year. Still another company, a well-known producer of gold in California, which uses about the same number of cars, rebuilds 25 of its cars annually. A copper company in the South is also building 25 cars a year, but to maintain the smaller stock of 125, the larger per cent of replacement being due apparently to more severe service to which the latter cars are subject.

Other Builders

Among the remainder who are building their own cars, two using 130 and 120 respectively rebuild annually about 8 per cent of this number. The largest operator on the list, a lead-silver producer in Utah, with between 700 and 800 cars in service, finds it necessary to build 40 per year. Where cars are bought instead of built for replacement, the annual figure runs about as given in the foregoing.

From these data one may see that the percentage of car replacement annually is fairly small, varying from 3 to 25. Unless subject to unusually severe service, mine cars last a long time. In the fact that it is usually necessary to replace only a small number of cars annually is probably to be found the reason why a little more than half of the companies considered are led to build or rebuild their own.

At the same time, the chances are that the car manufacturer can in most cases produce and deliver a lot of cars for less than the mining company can turn them out, if the latter makes the proper charges in estimating costs. The manufacturer can do this because of his superior organization for the work and the specialized skill of his employees, and because he produces on a much larger scale.

Moreover, even where a mining company claims to build its own cars, investigation will show that in most cases it buys the wheels it uses, as well as the bearings. This means that, after all, the home-made car in general is not produced as wholly on the premises, so to speak, as it seemed to be at the outset. Its cost to the mining company includes some profit for the wheel manufacturer and for the bearing company.

Fashion Changing

The day of the plain bearing for mine cars has by no means passed, but it is decidedly on the wane. Too many cars equipped with them are in service today for anyone to say that their day is over, but they are no longer fashionable and are surely passing out. Not, of course, because of mere fashion. but because they cost more to maintain and are wasteful of lubricant, and because a car equipped with them calls for the expenditure of more power by motor, man, or mule, in order to move it about.

Practically all of the mining companies referred to are using some form of anti-friction bearings on at least some of their cars, and each will tell the inquirer that he will specify such bearings on his next order. Anti-friction bearings have become standard equipment for mine cars, and it is only a question of time before the older type of bearing has disappeared, to be seen no more where ore has to be moved on wheels.

Chief among the reasons given by mining companies for their purchase of the car wheels they use is their lack of a foundry. All except one of the twenty companies referred to buy their wheels. But although admitting the lack of a foundry, one says that the wheels bought are cheaper than he could make if he had his own furnace, and two others, each of them large operators who build their own cars, say the bought wheels are more satisfactory.

Wheel Facts

Car wheels of cast iron appear to be still the most used. Wheels of cast steel, however, are not far behind them in popularity.

With welding practiced as extensively as it is, and the torch so widely used for building up worn equipment, one would expect to find some effort made to repair mine car wheels by methods of this sort. However, inquiry among operators has failed to reveal one who considers it worth while to bother with such repairs. One says that the decision would depend upon the defect, but that usually repairing would not pay.

A surprising difference of opinion appears to exist as to the part played by defective wheels in tramming and haulage wrecks. Operators quizzed declared for the most part that very few wrecks

could be attributed to wheel failure. In contrast two large companies in the West consider them more at fault. One asserts that such mishaps have been due largely to wheel and track defects; the other attributes 50 per cent of the accidents to the failure of wheels, the cost of such wrecks varying widely. Both purchased their wheels outside.

Your Choice in Idlers

Necessity for choosing between cast iron and steel arises in other cases than where car wheels are concerned. Idler pulleys furnish an instance. Though seemingly of small moment, the task of deciding upon one or the other material may cause a mill man or purchasing agent to scratch his head at times, especially when attempts to sell him both kinds are being made.

Indeed, the mill man may well keep scratching his head, for a referee can do no more than report "no decision" at the moment. Something may be said for both kinds of pulleys, not on the theory that there is some good in everything or everyone, but because both cast-iron pulleys and steel pulleys are in service today and are giving satisfaction. Whether one is better than the other is a matter of opinion, and the only individual competent to judge is the one who has used both under the same conditions. Moreover, if the conditions of conveyor operation be changed, a comparative test might give different results. Opinions of operators on the subject should be helpful.

What Users Think

A certain zinc operator, who has used both, observes that cast-iron idlers will probably be a little more resistant to wear from gritty material that clings to the belt. The chief difficulty with idlers of this type has been that they have had plain bearings and these have worn out faster than the rim. His steel idlers are all ball-bearing equipped, the result being that practically all of the loss arises from the wearing of the rim.

At a lead-silver mill in the Northwest, according to the manager, a cast-iron pulley conveyor has been in service continually for twenty years and is still apparently in excellent condition. Tubular cast-steel idlers are also used at this plant, but have not been in service long enough to warrant comparing them with the others. So far, after six or seven years they show no sign of failure.

Of two lead companies in the Middle West one "finds steel pulleys of greater advantage than those of cast iron." The other prefers "cast iron rollers, especially on wet and abrasive work. Steel tubular rollers have corroded through quickly in some of the service." This is reminiscent of the historic difference of opinion between Jack Spratt and Mrs. S. A Canadian mining company confesses it can find little difference in the way the two varieties wear. It rather inclines, nevertheless, toward tubular steel idlers, because they are lighter and less likely to break during shipping. On this latter point a Western company is also agreed, having had trouble with breakage when using cast iron.

From the referee's point of view the next round goes to cast iron. The plant reporting, which is in the Northwest, has no conveying problems, and all of the idler pulleys used are of cast iron. Most of them were made in the local foundry, but those most recently acquired were of a well-known line, made of tough gray iron cast in sand and equipped with anti-friction bearings. These have been in service sixteen months without replacement. The other idlers are of the same grade of material but have bronze bearings. A considerable number of these have been replaced, usually because the bearings would stick and the pulley stop rotating, the shell of the latter thereafter becoming worn through by the moving belt.

Two types of idlers are being used at another plant of the same company. One made by a certain manufacturer has a pulley of steel tubing with a malleable iron hub and ball bearings. This is used for heavy tonnages and conveyors up to 60 in. wide. Experience thus far has shown that it can be used only for finely crushed material. Where it has been employed for carrying large pieces of ore, the hammering of the latter as they pass over the idler soon destroys the steel tubing and often cracks the bearings. For this reason, the mining company designed a heavy cast-steel idler, which was then made for it by the manufacturer supplying the others. This idler has now been in use for three years without replacement. The opinion is expressed by the management, incidentally, that on any new installations. rubber-covered idlers will be used at all points where coarse ore drops on the belt.

Things That Get By

WITH the adage in mind that some people "have eyes but see not," a certain engineer set out one day on a trip around his plant for the purpose of proving to himself that he did not belong in that category. He wanted to discover if anything had been escaping his attention. The trip was quite successful; others followed. He saw another side of things that previously he had missed. Being methodical, he set them down in his notes.

One condition he found to be widespread throughout the plant. Certain tools and implements furnished the men usually failed in a certain place or in a certain way, indicating that their design was unsuitable for the work performed. The remedy for this was obvious—redesign them, although no one seemed to have thought of it before.

For example, mine pick handles were breaking all too frequently. His investigation showed them to be of too light design. This was changed to one of more sturdy lines. The picks, moreover, as received from the manufacturer, were not of a shape desired and had to be reforged before being sent underground. Their design was changed to meet average needs, the new pick costing no more than the old one.

Mine saws seemed likewise to be subject to unusually high breakage. Several thousand dollars' worth, he found, had been scrapped because of broken teeth. Inquiry disclosed that the purchasing agent a year or so before had changed from one well-known brand to another equally famous, because the latter was cheaper and was guaranteed by the maker to be just as good. Investigation showed that the saw was not adapted to the work being done. Although excellent for use on dry lumber, it was quite unsuited to sawing green mine timber, for which it was used, the teeth being too brittle to take the heavy set required.

Another thing the investigator saw was that in the shops high-priced material was frequently used where lower grade would have been just as good. In contrast, cheaper materials were sometimes used at higher ultimate cost than those costing more originally.

He also saw that liquid grease was being purchased in 25-lb. pails, although it was used at the rate of 100 to 150 gal. per month and the price in the small container was 3c. a pound over the barrel price, or, in other terms, 25c. more per gallon. On the other hand, some supplies were being ordered in such large quantities that they began to deteriorate before being used.

After a long investigation this engineer found that considerable defective or otherwise unsuitable material was being received, but that it escaped detection through sheer neglect. Designs of tools and structures and ways of doing things were often faulty, but continued in use simply because no one had been charged with the duty of ferreting such things out and correcting them. He concluded his study with a conviction of the need for systematically studying materials and operating practice, this as a basis for efficiency in the plant. This would seem to be axiomatic.

Three Steps

Investigation along these lines in various branches of work indicated to him that there are three steps to efficient practice. First, the weak point in design, construction, or practice must be clearly recognized. This done, a solution must be found. Finally the practicability of this must be tested and its soundness verified with respect to cost and operating efficiency. Thus the engineering mind would reason.

NEWS OF THE WEEK

Summary

AFTER a long period of depression, the Michigan copper district is enjoying a return of prosperity, largely through 18c. copper. Development and exploration are being undertaken by every producer in this district, the oldest copper-mining area in the United States. Page 864.

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American engineers are playing a prominent part in the industrialization of Russia, now being undertaken by the Soviet government. The more important contracts are detailed on page 866.

* * *

Construction of the new Nichols Copper refinery at El Paso, Tex., is nearing completion, and operation of this plant, the first of its kind in the Southwest, will probably start before the year. Page 867.

* * *

Noranda Mines is now handling 2,000 tons of copper ore daily at its smelter in the Rouyn district. The second reverberatory furnace was put into operation on Nov. 19. Page 868.

* * *

Output from the Mount Isa mine, in northern Queensland, is expected to be 70,000 tons of lead, 3,000,000 oz. of silver, and 4,800 tons of zinc annually when production is started next year on a basis of 2,000 tons of ore daily. Page 866.

* * *

The Mexican government has issued a detailed report on the geology of Nayarit. In Chihuahua, the unemployment situation resulting from the lack of power may be solved by transporting miners to other districts. A government fund for this purpose has been created. Page 868.

* * *

Ore reserves in the North Mount Lyell mine, Tasmania, Australia, have been increased 30 per cent during the last two years, although grade has fallen off somewhat. The daily tonnage extracted is also increasing. Page 863.

Sherritt Gordon Expects to Start Production at the End of 1930

C. D. Kaeding Estimates 5,250,000 Tons of Copper-Zinc Ore, Proved on Property in Northern Manitoba, Equivalent to Ten Years' Reserves—Program Outlined

PRODUCTION of 1,500 tons of copper-zinc ore daily will be started from the Sherritt Gordon mine, 100 miles north of The Pas, Man., at the end of 1930 if the present rate of construction work is maintained, according to C. D. Kaeding, consulting engineer of the company, in an official report that has just been released. Development work has already indicated 5,250,000 tons of ore, according to Mr. Kaeding. This is equivalent to a ten years' supply at the rate of 500,000 tons annually. It does not include probable or possible ore, and it has been proven since the Lindsley interests, which now control the mine, took it over early in 1928. The property extends 8 miles along the formation that has disclosed two major ore zones to date. Nothing unfavorable geologically has been disclosed in development, and Mr. Kaeding expects that other discoveries will be made.

A main working shaft is now being sunk 620 ft. east of the east line of the Ook claim at an angle of 51 deg. It has four 5x6-ft. compartments and one 6x6-ft. compartment for two ore skips, two service cages and a pipe-, cable-, and ladder-way. A double-track haulage drive will be driven at 500 ft. on the dip. At this level a jaw crusher, loading hoppers, and an ore bin will be installed. The surface plant will consist of a 100-ft. steel headframe, a 1,000-ton ore bin, a 400-ton waste bin, and twin hoists with 8x4-ft. drums. The ore hoist will operate at 1,000 ft. per minute and the cage hoist at 800 ft. per minute. These machines are being built in Scotland and will be delivered in January. They have been designed for a maximum depth of 2 000 ft. and can handle 900 tons in eight hours, consequently having a daily capacity three times the initial tonnage.

The east shaft, 2 miles away, will be deepened and equipped with a similar underground crushing plant, loading hoppers, and electric haulage. A 70-ft. steel headframe will be built and a cable tramway put up to connect this unit with the main shaft ore bin. The electric sinking hoist will be moved from the main to the east shaft. This unit will be able to handle 600 tons in eight hours.

Electric power will be obtained from the Flin Flon plant of Hudson Bay Mining & Smelting, 40 miles away, over the company's own branch line. A contract for all the power required for five years has been signed with Hudson Bay. About 5,000 hp. will be used in mine and mill operations, but the line capacity will be double this amount. In addition, the company has 350 hp. available from its Diesel-electric plant. The air compressors at the main shaft will be Bellis & Morcom machines in units of 2,500 cu.ft. each. At the east shaft, 940-cu.ft. Ingersoll-Rand compressors will be installed.

Ore will be crushed in the mine to minus 5-in. size before hoisting. From the ore bin at the headframe it will be fed over a special-type grizzly to a 7-ft. Symons cone crusher, and thence through a parallel arrangement of Hum-mer screens, oversize going to a 72x24-in. Garfield roll crusher. The final product, which will be minus $\frac{3}{8}$-in. size, will be conveyed to the concentrator bins. Mill tests are now being made for designing the concentrator. The plant will use selective flotation, making a 20 per cent copper concentrate and a 45 per cent zinc concentrate. Copper concentrate will be shipped to the smelter now being built at the Flin Flon mine. Zinc concentrate will be shipped to Montreal, where an electrolytic zinc refinery, presumably the one to be built by Noranda interests, will be constructed.

Exploration at Sherritt Gordon was done first by diamond drilling and later underground. A total of 118 holes was drilled, as well as 14,457 ft. of drifting and crosscutting, done to a depth of 375 ft. Development of the east zone disclosed structural irregularity and no ore in the central and eastern part as deep as 250 ft. The zone apparently rakes flatly to the northwest, as ore has been found on the 250 level west of the shaft. The length of the east zone is now 4,200 ft., with an average width of 15 ft. At the surface it is 50 ft. wide in places. The tonnage in this section is put at 866,000 tons of ore averaging 2.14 per cent copper, 5.75 per cent zinc, and 76c. a ton in gold and silver. The west zone is apparently

more regular in structure, although varying from 3 to 102 ft. in width. Average width is 15.5 ft. and length is 5,200 ft. This zone also showed a flat rake to the northwest, with the east end cutting out at shallow depths and the west end proved in places to 1,000 ft., vertically. This zone is estimated to carry 3,271,900 tons of 2.91 per cent copper, 2.76 per cent zinc, and 84c. a ton in gold and silver. In the central part a low-grade section, containing about 1,000,000 tons of ore averaging only 1.40 per cent copper and 0.80 per cent zinc, has been indicated. Work on this section has not been very thorough, however, and Mr. Kaeding expects that development will show it to be more nearly average grade.

Urquhart Believes New Guinea Comparable to Rand

INDICATIONS are that the gold properties under development by New Guinea Goldfields, subsidiary of Mining Trust, will prove to be of a magnitude unknown since the discovery of the Rand, Leslie Urquhart, chairman of the board of directors of Mining Trust, stated at the general meeting of the company in London on Nov. 12. Development work on the plateau deposit has been confined to a zone about 7,000 ft. long and 500 ft. wide. In this zone, the company has driven in ore for a length of 765 ft., showing an average value of 100s. a ton over a width of 38 in. The limits of the zone have not yet been determined. In the lower deposit, two crosscut tunnels, 300 ft. apart, have proved a width of 125 ft., assaying 35s. a ton. Several other important assays have been obtained in this part of the field.

Although the New Guinea field lies less than 30 miles from the coast, the hills make the transportation problem a difficult one. At present a detailed survey is being made of a combination of a cable tramway and narrow-gage railroad. Estimates indicate that provision for handling 2,000 tons daily could be made at a cost of about $1,000,000.

Abana to Crosscut Dike

Within the next two weeks, crosscutting of the diabase dike on the 550 level of Abana Mines, near Dupuy, Que., will be started to explore the ground lying east of the dike. Diamond drills indicated ore in this section. Trouble with the compressor delayed work at the mine somewhat early this month, but operations have been restored to normal. On the 425 level, drifts have been driven east and west on the zinc orebody, with assays of about 15 per cent zinc being maintained.

Mining Congress to Meet

Leaders in the mining industry of the United States will assemble in Washington from Dec. 4 to 7 for the 32d annual convention of the American Mining Congress. It will be attended by official representatives of several states, by officials of government departments in Washington that deal with mining matters, and by representatives of various organizations as well as credited mining delegates. The annual banquet will be held on Dec. 6, with Robert Tally, president of the organization, presiding and Representative Robsion as toastmaster.

Increase Mill Capacity at Villemagne Property

MILL capacity at the Mines de Villemagne, owning a silver-lead-zinc concession in the Cervennes Mountains of southern France, has been increased to about 450 tons daily, according to the progress report of Mining Trust, which controls the property. Costs have been reduced to 15s. a ton. During the first ten months of the year, the mill treated 110,292 tons of ore, with a production of about 8,600 tons of zinc concentrate and 3,000 tons of lead concentrate. This represents about a 25 per cent increase over 1928.

Development of the mine has more than kept pace with production. A new vein has been discovered about 260 ft. north of the main Villemagne vein. It carries slightly higher lead content than the ore now being treated. At the other end of the mine the deepest level is being driven west under the St. François shaft in high-grade lead ore.

Vertex Mill Started

Operation of the new 150-ton flotation plant of Vertex Mining, in the Silverton district of Colorado, was started on Nov. 23. The plant handles gold ore from the Buffalo Boy silver-gold mine. An 8,700-ft. cable tramway has been built to connect the mine and mill. Tonopah Mining controls the Vertex company.

Mount Bischoff Closes

Operations at the Mount Bischoff Tin mine, at Waratah, Tasmania, Australia, and the smelter, at Launceston, have been suspended because of the low price for tin. If conditions in the tin market improve, however, work may be resumed, according to T. G. Traynor, manager of the company. This is the first time the mine has closed since it was started, in 1873.

To Aid Boulder Perseverance

Recommendation that the Western Australian government aid in financing construction of a new metallurgical plant at Boulder Perseverance, in the Kalgoorlie district, has been made by the provincial Minister of Mines. Research work by C. E. Blackett, the company's metallurgist, on a modification of the bromo-cyanide process has indicated a considerable reduction in treatment costs. A 250-ton plant, to cost about $150,000, will be built.

North Mount Lyell Reserves Show 30 per Cent Increase

DEVELOPMENT work during the last two years has increased ore reserves at the North Mount Lyell mine of Mount Lyell Mining & Railway, in Tasmania, Australia, to 1,013,672 tons of 5.25 per cent copper, an increase of 291,842 tons, or about 30 per cent, over reserves in 1927. However, the grade is somewhat lower, according to the report for the year ended Sept. 30. Reductions in mining and transportation costs, made possible largely through completion of the North Lyell tunnel, permit the inclusion in the reserves of considerable material that was formerly considered junore. Improved facilities resulted in an increase of 30,000 tons in the output from this property. About 500 tons daily is being produced at present.

During the year the Lyell Comstock mine was reopened and about 8,000 tons of low-grade ore was produced. The rate of production is being increased gradually and is now more than 4,000 tons monthly. Reserves are estimated at about 600,000 tons of 3.25 per cent copper ore.

With reference to the extension of the Tharsis orebody, which was proved by drilling to a depth of 1,100 ft., the report states that the possibilities of the deposit are now being investigated. It had formerly been worked only to 400 ft. Although low-grade, the Tharsis ore is easily amenable to concentration. The North Lyell tunnel would afford cheap transportation.

A supplementary power station will be built at the Lake Margaret hydro-electric works, 5 miles from the reduction plants, to provide for increased demands. Operation of the new refinery has been extremely satisfactory and the refining cost is considerably less than when the company's blister was treated at custom plants. Production for the year was 7,803 tons of copper, compared with 7,060 tons for the preceding year.

Wilbert Makes Connection

Wilbert Mining has completed the connection on the 1,450 level between the north and south shafts at its property, 40 miles northeast of Arco, Idaho. Production of silver-lead ore is coming from the 1,350 and the 1,450 levels. Monthly output is about 300 tons of concentrate and 1,100 tons of crude ore. Earnings are averaging $6,000 to $7,000 a month.

Test Clinton-West Mill

The flotation mill of Clinton-West, leasing the dumps and part of the surface of Standard Consolidated, at Bodie, Calif., has been given a trial run. The plant, which can treat 100 tons in one eight-hour shift, handles the dump material by flotation after it has been put through a ball mill. Concentration is in the ratio of 225:1. The dump contains gold tailing.

Michigan Copper District Recovering From Long Depression

Increased Prices for Their Product Result in Prosperity for High-Cost Mines—Exploration Still Continues in the Region, Which Has Been Producing Since 1846

M. W. YOUNGS
Special Michigan Correspondent

RECOVERING from a long period of depression caused by the collapse of the metal market following the World War, the Michigan copper district is again enjoying better times. Many houses unoccupied for years—a haunting memory of busier days—are rehabilitated and once more shelter the families of workers, a large number of whom have returned to the district, which has been producing copper continuously since 1846 and is the oldest copper-mining district in the United States. To the credit of the mine managers, the years of depression were well utilized. In a district of comparatively high costs, caused by deep mining and irregular dissemination of metal in the veins, they set about to reduce operating expense so that copper mining in Michigan might continue. This they accomplished by increasing the capacity of equipment used in power tramming on long levels; adopting centralized hoisting wherever possible; eliminating boundary lines to permit more extensive openings; closer selection of copper rock; better mechanical loading underground; use of high-pressure air in drilling; improved metallurgy, particularly use of flotation; more efficient smelter practice; and cutting overhead.

The district in 1928 produced 178,442,704 lb. of copper. Recovery per ton of rock treated was 24.239 lb. This year output should approach 200,000,000 lb. Most producing units will show an increase, and Seneca has been added to the list. With copper at a higher level throughout the year, earnings are considerably greater. In 1928, the average price of copper was 14.57c. per pound. The gross cost of mine production was 12.078c. including depreciation, but exclusive of depletion charges. The gross cost for the combined output of mines and reclamation plants was 11.26c. Average profit was 2.677c. and 3.479c., respectively.

The active companies of the district are conducting a systematic search for new deposits or developing new ground in lodes which have proved their worth or have prospects of commercial mineralization.

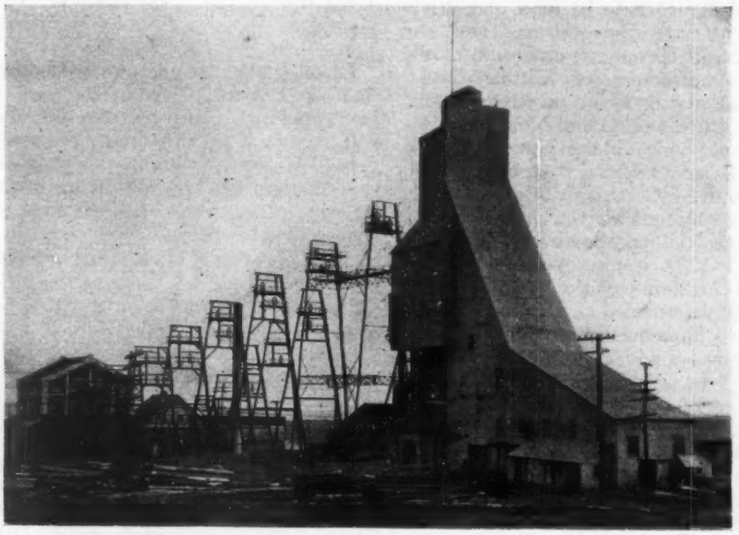
Calumet & Hecla Consolidated is engaged in exploratory work in Keweenaw County, where it has an extensive territory either owned or under option. Crosscutting and drifting are proceeding from the bottom of two old shafts, one in the Phoenix property and one in the Cliff. In addition, diamond drilling is being done at various points to obtain further geological information. Geological conditions and relationships in the Phoenix and Cliff, which are 2 miles apart, are almost identical, and furnish exceptional opportunity for thorough exploration.

In its conglomerate branch, Calumet & Hecla is developing new ground to the north. There is an extensive unexplored area lying below the No. 67 level in the slope shaft and north of the old North Tamarack workings. The No. 11 level of No. 3 North Tamarack shaft, which is equivalent to the No. 74 level in Calumet & Hecla workings, has developed ore of good stoping grade in its northerly extension. To explore it still further, drifts are being driven at lower levels. The shaft is bottomed at the No. 18 level, which is connected with the No. 87 level of Calumet & Hecla proper. From a raise north of the slope shaft, drifts on several levels have opened commercial ground. The future on the conglomerate at the north end appears promising. Meanwhile, ore is being developed in the Calumet & Hecla branches below the No. 81 level haulageway. This work is aided by electric hoists in the haulage tunnel, one serving "A" shaft at the Hecla, or south end, and one in "C" shaft at the Calumet, or north, end.

In the Kearsarge amygdaloid department, a stoping area has been opened just north of the line of No. 2 Centennial shaft by a drift south on the No. 43 level from No. 1 North Kearsarge. The Centennial shaft now is being completed to the No. 43 level, facilitating further exploration of the lode to the south at depth. In Ahmeek, Calumet & Hecla's big producer on the Kearsarge formation, former Allouez territory is being worked through No. 2 shaft. The ore is low grade, but a large tonnage is available. Heavier haulage equipment has been installed for mining low-grade ore at long distances from the shaft. Ample unexplored territory exists in Allouez for the development of reserves.

In the Osceola lode department, the vein will be investigated at a depth of several thousand feet below the present workings. For this purpose a crosscut east from the No. 78 level of No. 12 conglomerate shaft is nearing the point of contact. The lode will be opened both north and south to test its mineralization. If it carries ore at this great depth, the life of the Osceola branch, which is being worked through five shafts, will be greatly increased.

Production from Calumet & Hecla's reclamation plants will begin to decline after this year because of the depletion of the high-grade conglomerate sands at the Calumet mill. The remaining sands at the Hecla and Tamarack mills are contaminated by amygdaloid tailing, which will lower the grade and decrease the annual output of copper. Final exhaustion of the sand banks within the next seven or eight years, however, should find the company well prepared with new reserves in its mines to enable it to maintain a high rate of production.



Headframe at Quincy's No. 2 shaft

Mohawk has only a few years of life left on the Kearsarge amygdaloid, but it is preparing for final abandonment of operations there by reopening the Michigan mine, in Ontonagon County. It has greatly enlarged its territory at the Michigan by acquiring adjacent properties, giving it an extensive area on the Butler lode. This vein will be opened extensively to provide a large volume of production. "E" shaft is being unwatered, and sinking is expected to be under way before the end of 1929. The shaft, which is only 879 ft. deep, will be sunk to the 2,000 level before any extensive drifting is done in the Butler lode. The property also carries other veins which will be in-

The Calumet & Hecla reclamation plant at the Tamarack mill

vestigated. By the time the Mohawk mine is abandoned, Michigan should be in position to take its place as a producer. The Butler lode has shown good grade in the past. On this showing, and the fact that the acreage is adequate, Mohawk is staking its future.

Copper Range is engaged, through Champion Copper, in exploratory diamond drilling in an extensive tract in the south range district. Copper Range and the St. Mary's Mineral Land Company each own a half interest in Champion. Drilling is proceeding in lands conveyed by these companies to Champion. The Ashbed or Atlantic lode now is being investigated. Other parts of the tract will be given attention later. Copper Range and Champion have ownership or control over all lands on the mineral formation from the Atlantic mine to the south boundary of the Globe tract, a distance of nearly 9 miles, and for the next 2½ miles to the south the lands are controlled by the Copper Range and St. Mary's companies. The ownership is sufficiently unified to permit thorough exploration. The possibilities in this extensive tract are considered good.

Quincy will not get into large production until sufficiently opened at depth to enable it to adopt the retreating system of stoping. The Pewabic Main lode and its branches are being developed through three shafts, and the total of new openings to date is about 34,000 ft. In No. 8 shaft, raising and sinking are proceeding. As soon as possible the shaft will be put down to the depth of Nos. 2 and 6. Sinking is under way below No. 79 level and raising above No. 85 level. Quincy grade is being well maintained at depth, and the management is aiming at an ultimately large tonnage.

Isle Royale, which is operated by Calumet & Hecla, is exploring a large area of ground in No. 2 shaft. Drifting was started on the No. 33, or bottom, level. That portion of the lode lying below and tributary to this shaft will be opened by sinking and drifting.

Arcadian Consolidated, which is in the development stage, is sinking its New Baltic shaft from the 1,700 to the 2,000 level to test the mineralization in both the New Arcadian and Arcadian lodes. The showing of copper in upper levels is encouraging. More settled ground is looked for at depth.

Mayflower-Old Colony holds the record in the district for persistence in exploration in the face of many discouragements. An amygdaloid vein with a promising showing of copper is now being opened. It was encountered in a crosscut 4,842 ft. from the shaft at the 1,700 level. The crosscut is the longest exploratory opening ever driven in the district. The vein will be opened extensively to test the mineralization.

Cheaper power for the district is in prospect with a start on the development of water power in Ontonagon County. Work on the first of a series of large dams has been started by the Northern Acquisition Company on the Ontonagon River. The company has planned a several years' program of construction and development. Power lines will be built into Houghton County, where the mining industry is largely centered.

No official production figures, so far as the major producers are concerned, are available. The majority of the companies of the district make it a practice to report production figures only in their annual statements. Estimates of current production, however, give Calumet & Hecla Consolidated a monthly output of approximately 10,500,000 lb. of refined copper; Copper Range, 2,400,000 lb.; Isle Royale, 1,000,000 lb.; Mohawk, 1,800,000 lb., and Seneca, 300,000 lb. Quincy is sending only ore from its drifts to the mill. Seneca is still in the development stage, but is shipping sufficient ore to keep one stamp head in commission. Seneca has a large area on the Kearsarge lode and is opening it extensively both laterally and at depth through two shafts. It is finding values encouraging, and, with sufficient drifts, a large tonnage should be possible.

All the producing companies have adopted flotation in the treatment of amygdaloid ores, the process having been developed by Arthur W. Fahrenwald when he was on the staff of the U. S. Bureau of Mines, in conjunction with the research department of the Michigan College of Mining and Technology at Houghton. The process results in a saving of 2 to 4 lb. of copper per ton, according to the richness of the ore. It marks the greatest advance in metallurgical practice in the district in recent years.

New York Section to Hear About Alloy Steels

MINING engineers in the vicinity of New York City will have an opportunity to hear about the use of chromium and other alloy steels in construction, at the meeting of the New York section of the A.I.M.E. on Wednesday, Dec. 4. The speaker of the evening will be C. E. MacQuigg, manager of the research department of the Union Carbon & Carbide Corporation. Steel work of the new Chrysler building is expected to receive especial attention.

At this meeting, also, S. Skowronski will present the James Douglas medal to Paul D. Merica. Dr. Merica was awarded this medal early in the year, but circumstances have hitherto prevented its formal presentation.

The meeting will be preceded by the usual dinner at the rooms of the Building Trades Employers' Association, 2 Park Ave., at 6:30. Those who intend to attend should make reservation through L. F. Strobel, Room 5002, 233 Broadway; telephone Fitzroy 9668.

California Has Low Accident and High Compensation Rates

CALIFORNIA in 1927 ranked eleventh in mine fatalities and ninth in injuries of the 32 states listed in the report on metal-mine accidents during that year, recently issued by the U. S. Bureau of Mines. Its accident rate was 3.15 men killed and 256.84 injured per 1,000 workers. Although California has one of the highest workmen's compensation insurance rates of any metal-producing state, with a basic mine rate of $9.42 per $100 payroll, its accident record is better than the record for such states as Arizona, Colorado, Idaho, and Utah. G. Chester Brown, secretary-treasurer of the California Metal and Mineral Producers' Association, believes the cost of this protection for employees is causing undue hardship on mining operations in the state.

Wanderer Starts Plant

Operation of the new 500-ton plant of Wanderer Consolidated Gold, in the Selukwe district of Southern Rhodesia, was started during October. Extraction is reported to be 90 per cent. The company holds a total of 916 claims, most of which were acquired from Gold Fields Rhodesian Development in June, 1928. About 750,000 tons of 5.5 dwt. ore has been proved by development work to date. Several new orebodies have been found, and development is expected to increase reserves considerably.

Mount Isa's Lead Output Put at 70,000 Tons Annually

PRODUCTION from the smelter now being built at Mount Isa, the Mining Trust lead-zinc property in northern Queensland, Australia, will be about 70,000 tons of lead, 3,000,000 oz. of silver, and 4,800 tons of zinc annually, according to a progress report issued by the company. This is on the basis of treating 2,000 tons of ore daily, of which 1,500 tons will come from the carbonate deposits. Operation of the plants is expected to start in August, 1930. With the increase of the tonnage handled to a point commensurate with ore reserves, the proportion of sulphide ore from the Black Star mine will increase, with a consequent rise in zinc output. Mining Trust engineers are studying the possibilities of electrolytic and other methods of zinc production, so that steps may be taken in this direction before large-scale treatment of sulphide ore begins.

At present, ore reserves are estimated at 24,285,000 tons, of which 4,000,000 tons is carbonate ore carrying no zinc, above the 750 level. Diamond drilling has indicated that the ore continues to 1,000 ft., so that these figures will evidently be increased. The Black Star orebody, which has been proved for a length of 2,200 ft. and widths up to 230 ft., is being drilled to determine the northern and southern limits, which have not yet been found. Ore is also expected to continue to greater depth.

According to a recent interview with Leslie Urquhart, the cost of bringing Mount Isa into production will be about $10,000,000. Estimates indicate that, with metal prices at about their present levels, an annual profit of $3,500,000 can be made on the basis of 2,000 tons daily. About $15,000,000 additional would be required to step the mill up to 5,000 tons daily and to construct an electrolytic zinc plant. Treatment of the ore under the present program was outlined by E. C. B. Heden in our issue of Nov. 16.

Gold Tellurides Found in Sumatra for First Time

GOLD tellurides, which had not previously been found in the Malayan archipelago, have been discovered in a copper-bearing quartz reef near Padang, on the west coast of the island of Sumatra, Netherlands East Indies, according to L. Hundeshagen, of Stuttgart, Germany. The property is known as the Flory concession. The ore contains copper pyrites and arsenic in addition to a small percentage of gold tellurides. Assays run from 2 to 6 oz. of gold a ton.

Pyritic ore with silver-lead tellurides, assaying about 30 oz. of silver and some gold, has occasionally been found south of Padang. Mr. Hundeshagen has found lead carbonate ore north of Padang, also carrying a little telluride, with gold and silver.

American Engineers Prominent in Industrialization of Soviet Russia

I. D. Foos
Washington Correspondent

THE lack of official relations between the U.S.S.R. and the United States has not prevented Soviet industry from developing along American lines. Its growth is stimulated by thirty-odd technical-aid contracts between the Soviet government and American engineering and manufacturing firms whose capital investment is nil. Under these contracts, firms in the front rank of American industry are furnishing plans, patterns, and formulas to numerous Soviet industrial organizations and factories, and sending their own experts to train Russian technicians and workmen to lay out plants, and build, set up, and run the machinery.

The concept of the Soviet Union for the economic rejuvenation of Russia is amazing in its scope. American engineers have been brought in to superintend the erection of an economic structure of towering dimensions upon a foundation of material resources perhaps richer than those possessed by the United States. Fostered by American ingenuity, intelligent exploitation of Russia's resources eventually may establish its independence. It is a socialist state that is growing sounder economically every day. Its stability rests upon acceptance by its people. If they stand for it, the Soviet Union can stand alone, unique among the governments of nations, but occupying a position that in time may compel recognition of its importance in international commerce.

American engineers are helping the Soviet to bring this vast concept to realization. Intrigued by the tremendous projects sketched, they are working not only for the gold that the Soviet state so promptly pays, but for the glory of achievement. They are not disturbed by the fact that they are shaping the destiny of a nation that one day may rival the United States in material wealth. This enthusiasm for the job is not shared by the smaller fry attracted to Russia by the high wage that the Soviet pays for skillful craftsmanship. For them it is exile, as their money cannot buy the environment that to them is life. Neither do the Soviet workmen respond to the stimulus that is spurring on their leaders. They resist the efficiencies of American methods.

Progress must wait upon the capriciousness of the human element, and consequently is slow. Even those who are prone to be enthusiastic about Soviet enterprise are inclined to think sometimes that American firms whose services the Soviet has contracted for have bargained for more than they can deliver. It must be remembered, though, that they have not invested a dollar and that many of the technical-aid contracts call for the purchase of American equipment of one kind or other that runs into millions of dollars paid for in cash in New York prior to shipment.

The projects under the direction of American genius cover practically every major branch of industry. Perhaps the most spectacular is the Austin Company's contract for the design and construction of a large automobile plant at Nizhni Novgorod, to be completed not later than the fall of 1931. Costing approximately $40,000,000, this plant will have an annual production capacity of 120,000 cars and trucks of Ford A and AA models. Technical aid will be furnished by the Ford Motor Company for a period of nine years during and after completion of the Nizhni plant. The Ford contract provides for the purchase in the meantime of $30,000,000 of cars and parts. Arthur J. Brandt, of Detroit, is under contract to reorganize the AMO Truck Plant at Moscow for a capacity of 25,000 2½-ton trucks. The Hercules Motor Company is providing the motors for the Yaroslavl truck plant.

To supply the requisite power for industrial plants, the Hugh L. Cooper Company, New York, is engaged on a hydro-electric project long contemplated by the Czarist regime. Mr. Cooper and his associates designed and are superintending construction of an 800,000 hp. plant at the rapids of Dnieper River near Dnieperpetrovsk. In round numbers, it will cost $150,000,000.

Complete mechanization of the Soviet coal-mining industry is in the hands of Stuart, James & Cooke, New York; Allen & Garcia, Chicago; and Roberts & Schaefer, Chicago. These contracts call for the establishment of new mines, beginning with the bare ground, and modernization of the Donets mines. Freyn Engineering Company, Chicago, is working on two contracts for expanding the steel industry in southern Russia and the Ural Mountains. Fifteen American engineers have been sent over to work with the Soviet state planning board in constructing eighteen new foundries and rolling mills and re-equipping forty existing plants at a cost of $1,000,000,000.

The Frank D. Chase Company, Cleveland, has a contract for supervising reorganization of one foundry that has now been extended to cover others, particularly in the Stalingrad tractor plant, to be designed and erected under the supervision of Albert Kahn, Inc., Detroit, at a cost of $4,000,000. The Ford Motor Company has been called in as a consultant on this project.

Contracts with the International General Electric Company and the Radio Corporation cover patent rights and involve purchase of a considerable amount of electrical machinery and equipment.

The first order received by the Radio Corporation totaled $1,000,000. The Sperry Gyroscope Company, Brooklyn, has been asked for advice on low-tension electrical engineering. Construction of a sewing-machine factory in Moscow is in the hands of the Taft Pierce Company, Detroit. Engineers of the McCormick Company, Pittsburgh, have supervised the construction of a large mechanical bakery in Moscow and are planning others. Orders for $2,000,000 of oil-refining equipment have been placed with the Foster Wheeler Corporation, New York, which will superintend its installation.

Longacre Engineering & Construction Company, New York, is supervising a housing construction program that calls for building apartment houses, schools, dining halls, and other municipal projects up to $5,000,000 each year for five years. The Mechanical Manufacturing Company and Blom & Kamroth, Chicago, have contracts for planning and equipping modern meat-packing plants at several central distribution points. The Soviet recently purchased in their entirety the plants of the Dueber-Hampden Watch Company and the Ansonia Clock Company. This equipment now is being tested prior to its transfer to Russia, where it will be set up in the same form.

Reorganization and reconstruction of Soviet textile mills by Lockwood Greene Company, New York, is one of the most extensive projects which American engineers at present in Russia have undertaken.

Henry D. Gibbs, chemical engineer, of Washington, D. C., has been engaged to organize the production of chemicals used in the aniline dye industry. Parke, Davis & Company, Detroit, has been retained as consultant in developing pharmaceutical, chemical, and drug production. E. B. Badger & Sons, Boston, has been called in on chemical engineering work. Construction of cement mills and installation of equipment are in the hands of the MacDonald Engineering Company, Boston. A contract with the C. F. Seabrook Company, New York, covers road building in Moscow Province, and another engineering concern is considering the technical direction of similar work.

Archer E. Wheeler and two other American engineers have been retained for technical assistance in developing the production of copper and other nonferrous metals. An American engineer (his name is Smith) is at work in the Putilov plants in Leningrad. These plants produce locomotives, cars, tractors, and machinery and employ more labor than any other industrial establishment in Russia. The Graver Corporation, East Chicago, Ind., is coaching the Soviet on petroleum production and refining methods. American experts also are shaping the Soviet program for exploitation of timber resources and the establishment of pulp and paper mills.

For the purpose of restoring to Russia its pre-eminence as a base of European food supply, the Soviet Union is applying to agriculture the same extensive reforms that it is introducing in industry. The Nitrogen Engineering Company, New York, is working under a ten-year contract for the design, construction, and preliminary operation of a synthetic ammonia plant to cost $10,000,000. A contract with E. I. du Pont de Nemours & Company provides for the utilization of that company's process in ammonia production. M. L. Wilson, of Montana State College, and a representative of the Caterpillar Tractor Company have been retained to manage the state grain farm established with a view to increasing to 6,000,000 acres the area planted to grain. Arthur P. Davis, former chief of the U. S. Reclamation Service, and his associates are under a two-year contract to lay out an irrigation system in Turkestan for the cultivation of cotton on an extensive scale. Franklin Harris, president of Brigham Young University, Utah; J. B. Davidson, Iowa State College; and Benjamin Brown, North Carolina University, also are engaged in agricultural extension work. Supported by funds contributed by American Jews, similar work is being carried on in Siberia on the farms of 10,000 Jewish families removed by the Soviet from European Russia.

Most of the technical-aid contracts described were made during the Soviet fiscal year ended Sept. 30, 1929. To them may be traced directly and indirectly the increase of $17,000,000 in exports over the preceding year. Orders for industrial and electrical equipment doubled, reaching a total of nearly $30,000,000. Purchases of equipment for the petroleum industry amounted to $9,600,000 and for steel mills and the machine-tool industry $5,500,000. Equipment for the construction of power plants totaled $3,600,000. Orders for agricultural equipment, principally tractors, totaled $30,000,000 and automotive equipment, $8,000,000.

Spain May Limit Mine Output

Mine production from Spanish properties may be limited by the Spanish Council of Ministers, according to a recently adopted regulation. Producers of certain minerals, particularly of iron and potash, must have the approval of the government before any radical changes can be made in the quantity of production. This step has been taken as part of a program to foster home industry. No definite curtailments have yet been made.

Farmers Win in Fume Suit

Judgment for $4,456.25 was awarded seven farmers in the Verde Valley of Arizona by Judge Jeremiah Neterer in the federal court at Prescott, Ariz., for damages to their properties from fumes coming from the United Verde Copper smelter at Clarkdale. About $7,000 was asked by the plaintiffs.

El Paso Refinery Will Start Within a Month

OPERATION of the new refinery being built by Nichols Copper at El Paso, Tex., will be started by the first of the year. The plant will have a capacity of 100,000 tons of copper annually and has been built at a cost of about $4,000,000. It will handle part of the output of Phelps Dodge, Calumet & Arizona, and United Verde Extension. A saving of about $4 a ton in freight on copper going to Europe via Galveston is expected, as compared with the cost when blister from the Arizona smelters of the three mining companies is shipped to Eastern refineries. A saving is also expected in freight on copper going to the Middle West.

Construction of an anode-casting plant at the Douglas smelter of Calumet & Arizona has been completed, and the first anodes have been produced. All copper shipped to El Paso will be in the form of anodes. Construction of the anode plant at the Copper Queen smelter of Phelps Dodge is not yet completed, but will be in operation before the refinery starts. The Clifton smelter, handling concentrate from Phelps Dodge's Morenci branch, has been equipped to produce anodes for some time.

Inland Steel to Sink Shaft on Michigan Property

INLAND STEEL will sink a shaft on its lease in Section 23, Township 48, Range 27 North, on the Marquette range in northern Michigan, according to C. B. Randall, assistant vice-president of the company. Diamond drilling has indicated high-grade hematite and magnetite. The new shaft will measure 12 x 12 ft. inside the timbers and will go down to 1,050 ft. A contract will be let to sink the shaft to the ledge, which is 105 ft. deep, and the company will complete the work.

This is the first entrance of Inland Steel into the Michigan iron country, although it operates properties on the Cuyuna and Mesabi ranges in Minnesota. Demand for hard iron ore is very brisk at present, stimulating diamond drilling on the Michigan ranges, particularly the Marquette and the Menominee.

Michigan Survey Parties to Continue Work Next Year

Work of the magnetic and iron survey parties of the Geological Survey division of the Michigan Department of Conservation will be continued during the summer of 1930, according to R. A. Smith, state geologist. A third year of work was practically completed in September. The magnetic survey is working on the field distribution of different beds in the copper-bearing series between Houghton and Calumet. The iron survey party was exploring west of Ishpeming for deposits of hard ore.

Mexico City Letter

By W. L. Vail
Special Correspondent

Report Issued on Geology of Nayarit—Government Aids Miners at Veta Grande

Mexico City, Nov. 23, 1929.—The mining section of the Department of Industry, Commerce, and Labor has just issued a brochure dealing with mining conditions and geology of the State of Nayarit. This is one of the smallest states in the country, about 27,000 sq.km. in area, but it is intensely mineralized. The opening of the Southern Pacific railroad through the territory and better port facilities have recently drawn attention to the section. Copies of the report can be obtained by addressing the department at Mexico City.

CHIHUAHUA papers report the state government has assisted miners out of work in the districts affected by the power shortage, particularly Veta Grande, by putting aside a sum to provide means for transportation to other districts where employment may possibly be obtained. Large numbers of men are still being thrown out of work by the lack of power resulting from the drought in this section.

The Potosi unit of the Howe Sound Company, near Chihuahua City, is operating on a basis of only 800 tons daily, as compared with 1,400 to 1,500 tons before the power situation became acute. As the Calera unit has been closed, the Potosi unit is the only producing property of the company in Mexico. Its capacity was increased last spring to make possible maintenance of output. Power requirements at Potosi were about 2,500 hp. Only about 60 per cent of this is now available.

September taxation yield from mines is put at 1,133,573 pesos, compared with 1,129,056 pesos in July and 861,744 pesos in August. Receipts for October have not yet been announced, but they are expected to compare favorably with these returns. Production figures are available only for the first seven months of the year, but evidently Mexico's mine production will be less than last year. The revolution in the spring is probably the most important factor in the decrease.

Nabesna Mining Formed

Nabesna Mining, with headquarters at Chitina, Alaska, has been formed by Carl F. Witham to operate gold properties in the Nabesna district. Several veins have been found on the property. During the winter a 150-ft. tunnel will be driven for mining the orebody, and preparations made for mill construction. A 2,000-ft. tramway will be built to transport timber to the mine and carry the ore to the mill. Mr. Witham is now in Seattle buying supplies, about 25 tons of which will be shipped to the property this winter. About $80,000 will be needed in the project, all of which will be raised in Alaska.

Find Chromite in Ontario

A large deposit of chromite has been found near the main line of the Canadian National railroad, 30 miles west of Lake Nipigon, Ont., according to C. V. Bob & Company. Consolidated Chromium Corporation has been formed, with a capitalization of $14,000,000, to exploit the deposit, said to be 6,000 ft. long and 600 ft. wide. Golden Centre Mines and C. V. Bob & Company incorporated Consolidated Chromium.

Base Metals Mill Started

Operation of the new 350-ton mill at the Base Metals property, Kicking Horse district, British Columbia, was started Saturday, Nov. 16, according to George Wingfield, of Goldfield Consolidated, which controls Base Metals. Operations will gradually be stepped up to capacity. E. A. Julian, president of Base Metals, left the property on Nov. 18 to return to Nevada. The drift on the orebody has been driven 810 ft. and contains high-grade ore in the face.

Ship From Mines Near Ely

Cuba Mining, operating a lead property and a manganese property near Ely, Nev., is shipping from both mines. Manganese ore is being shipped to the Ironton plant of Columbia Steel, recently acquired by U. S. Steel. Lead sulphide ore is being shipped to the Midvale smelter of U. S. Smelting, Refining & Mining. Three carloads of 76 per cent lead ore were shipped recently.

Develop Coquimbo Claims

Tocopilla Mining, which operates a copper mine and mill at Tocopilla, Province of Antofogasta, Chile, has acquired the old Panulcillo copper properties, in the province of Coquimbo. About $100,000 will be spent in development work to determine the advisability of installing a small concentrating plant. At its Antofogasta properties the company is producing about 2,000 tons of high-grade ore and 600 tons of 30 per cent concentrate monthly.

Progress With Amulet Mill

Construction of framework for the new 300-ton selective flotation plant being built in the Rouyn district, Quebec, has been completed by Amulet Mines, and erection of the ore bins has been started. The spur line of the Canadian National railroad is also making good progress and is expected to be ready by the beginning of 1930. The last official estimates placed Amulet's reserves of copper-zinc ore at about 500,000 tons, to which recent diamond drilling is reported to have added another 50,000 tons.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Noranda Tonnage at 2,000—No Decision Yet Made on Dome Mill

Toronto, Nov. 23, 1929.—On Nov. 19, Noranda Mines stepped up the tonnage handled at its smelter in the Rouyn district to 2,000 tons of copper ore daily by putting the second reverberatory furnace into operation. Less than two years ago this plant was started with one furnace handling 500 tons daily, although for the last year or so as high as 1,300 tons has been put through the one unit in a single day. The present tonnage is not expected to be the maximum capacity of the plant. The No. 4 shaft, which was sunk last winter and spring, has also been put into operation, as sufficient tonnage could not be hoisted through No. 3 shaft.

NO DECISION has yet been arrived at in connection with the Dome mill, burned last month, and no definite announcement may be made for another month or two. Underground work at the mine in the Porcupine district is proceeding, however, and the clean-up of the old mill is under way. Between $300,000 and $400,000 in gold may be salvaged from the wrecked machinery.

On Nov. 22 word was officially received from the rescued MacAlpine party, which had been unreported for more than a week. The fliers, who now have four planes, are at Fort Reliance, where radio communication is not available. They are waiting for ice to form on Great Slave Lake before proceeding to Fort Resolution.

At the annual Teck-Hughes meeting in Buffalo, on Nov. 19, D. L. H. Forbes, the general manager of this Kirkland Lake enterprise, presented a review of operations since the close of the fiscal year on Aug. 31. He stated that exhaustion of ore above the No. 10 level had been deferred for another year, and that plans for treating tailing had been completed. Material averaging $4.50 a ton is available from the old mill dump. Development on the Nos. 20 and 21 levels is about half completed, with ore proved for 1,280 ft. The grade is about the average run-of-mine ore.

Sudbury Offsets, Ltd., plans to start to sink a shaft in January on its property in Foy Township on the North nickel range, in the Sudbury district. Diamond drilling on this property, which covers the Foy "offset" for a length of about 2½ miles, has disclosed a large amount of nickel-copper mineralization. Officials are confident it will develop as ore. In the event that Sudbury Offsets should desire smelter accommodation, assurances of co-operation are understood to have been received from interests controlling the Falconbridge plant.

MARKET AND FINANCIAL NEWS

Cut in European Zinc Output Seen as Necessary Step for Industry

INTERNATIONAL METAL SERVICE, LTD.,
LONDON

Nov. 8, 1929—October has indeed been a tragic month for all connected with the zinc industry. By the beginning of the period the London quotation had slipped to a figure as low as that which was the prime factor in bringing the European cartel into being.

Outside the question of a revival of demand for galvanized sheets from India, there is little chance of any marked increase in the rate of absorption of zinc products until after the turn of the year, and unless we are all sadly at fault in our reading of the position, output is somewhat in excess of the current level of consumption. Added to which, in more than one country money is tight, and there is no sense in locking up much in stocks. Hence, everything conspired to bring about a downward trend in the London quotation for slab zinc, and by the end of the month further losses of practically 30s. per ton had to be recorded, October shipment closing at £22 1s. 3d., as against the final September price of £23 10s.

One thing would appear to have emerged from the welter of perplexities which has so confused the issue of recent months—that is that the European cartel has no power to compel its constituent members to abide by decisions arrived at; and that some alteration is vitally necessary whereby this power would be acquired. In the matter of the output by Germany and Poland, the September figures of these two countries show that the curtailment which it was understood had been agreed upon, and which was to become effective as from Aug. 1, had not been put into force. Without in any way desiring to apportion, or even attribute, blame, the point is made that it had been agreed that a further curtailment was necessary and the extent of it agreed upon.

This in itself was enough to set tongues wagging; suggestions have been made that the other countries were tired of doing their part and of seeing their efforts rendered of no value by the inability of others to pull their weight. From this to rumors that the cartel would not be renewed was a short step, but they all had a share in further depressing sentiment. Since then there have been counter-rumors that Poland now sees eye to eye with the other countries on the point of curtailment and will wholeheartedly co-operate in any future decisions; and another tale goes so far as to say that it has been decided to institute a "pooling" system with bonuses for under-production and fines for overproduction.

At the present moment it would be far better to make too heavy a cut in production rather than one which the market considers too small and which would in itself tend to aggravate the present illness from which the industry is suffering. For ourselves, we are of opinion that a bold policy would go a long way toward stopping the rot which appears to have set in; though we should not like to commit ourselves definitely to a statement that there would be any instantaneous improvement in sentiment.

Another point on which we rather join issue with other critics of the position is in the constant iteration of the statement that present stocks are not excessive. We are told that though the accumulations on smelters' hands are growing, the rate of increase is not heavy and that even now the tonnage is less than one month's output, whereas before the war it was quite usual to carry a full month's production. The true criterion at times like this is: Do these stocks embarrass producers, or are they able to carry them without any inconvenience? As to this, of course, the market tells its own tale—rumors that it is by no means difficult to get all the metal required at under parity are not rare.

World stocks of zinc on Nov. 1 follow:

	Metric Tons
United States	51,800
Canada, including afloat	3,800
Germany-Poland	15,600
Belgium	9,800
France	1,900
Great Britain	3,600
Other Europe	2,500
Australia, including afloat	4,000
Far East	1,000
Elsewhere	1,900
Total	95,900

Recently some slight betterment in the demand for galvanized sheets has been noted, but the amount of business passing still is below normal. Heavily discounting the pessimism of German advices, the activity in the brass trade there is undoubtedly subnormal, and as to zinc sheets, rollers are apparently not likely to enlarge their operations until the outlook is decidedly clearer than it is today.

Hecla Mining Profit Up

Hecla Mining Company, operating in the Coeur d'Alene district of Idaho, reports for the quarter ended Sept. 30, 1929, a profit of $439,440 after expenses, ordinary taxes, and depreciation, but before federal taxes, comparing with $546,318 in the preceding quarter and $272,931 in the third quarter of 1928. Profit for the nine months ended Sept. 30 totaled $1,478,796 before federal taxes, against $986,104 in the first nine months of the preceding year.

Earnings of Corporations in Metal-Mining Industry

(Courtesy of The Standard Statistics Company)

Name of Company	Earnings per Common Share 1926	1927	1928	Estimated for 1929
Anaconda Copper	(a) 4.74	(a) 3.37	(a) 7.38	11.00
Andes Copper	.....	(a) 0.10	(a) 1.10	4.00
Calumet & Arizona Mining	.....	.....	(a) 9.22	11.00
Calumet & Hecla Consolidated Copper	0.75	0.29	1.55	4.00
Cerro de Pasco Copper	4.05	3.26	5.13	8.00
Chile Copper	(a) 2.65	(a) 2.51	(a) 4.52	6.75
Granby Consolidated	(a) 1.54	(a) 0.22	(a) 3.45	8.00
Greene Cananea Copper	(a) 1.17	(a) 1.16	(a) 3.95	9.00
Howe Sound	5.44	(a) 4.32	(a) 5.34	7.50
Inspiration Consolidated Copper	(a) 1.11	(a) 0.62	(a) 2.93	4.50
Kennecott Copper	(a) 2.90	(a) 3.11	(a) 5.01	7.00
Magma Copper	2.96	(a) 2.02	(a) 4.78	7.50
Miami Copper	(a) 1.52	(a) 1.53	(a) 2.47	5.00
Nevada Consolidated	(a) 1.87	(a) 1.18	(a) 3.13	4.50
Phelps Dodge	(a) 2.06	(a) 1.14	(a) 5.04	5.00
United Verde Extension Mining Company	(a) 2.52	(a) 1.62	(a) 3.24	4.00
Aluminum Company of America	.....	3.28	7.09	9.00
American Metal Company, Ltd	3.88	(b) 3.64	3.58	7.60
American Smelting & Refining	(b) 7.79	6.55	8.24	10.00
Federated Metals Corporation	(d) 1.95	1.42	3.29	3.90
Hecla Mining	1.88	1.58	1.58	1.90
International Nickel Company of Canada, Ltd	(b) 0.50	(b) 0.55	(b) 1.05	2.00
McIntyre Porcupine Mines	(a) 1.25	(a) 1.82	(a) 1.94	1.90
Noranda Mines, Ltd	.....	.....	0.77	2.50
Patiño M. & E.	3.10	3.47	3.78	3.75
U. S. Smelting, Refining & Mining	(c) 3.81	(c) 3.79	(c) 3.50	5.00
Vanadium Corporation of America	5.50	4.97	4.55	5.00

(a)—Before depletion; (b)—adjusted earnings; (c)—after extraordinary charges.

October Copper Output Above 1928 Level

WORLD copper output in October was 178,269 tons, against 174,553 tons in September, and 176,623 tons in October, 1928, according to the American Bureau of Metal Statistics. The daily rate of production for October was 5,751 tons, comparing with 5,818 tons in the preceding month. Production of copper in September, October, and the ten months' period of the current year, by countries, in tons, follows:

	Sept.	Oct.	Jan.-Oct.
United States...	92,538	97,405	994,619
Mexico.....	5,108	4,986	53,579
Canada.....	6,949	7,268	64,619
Chile and Peru..	30,801	31,152	338,562
Japan.....	7,291	7,802	66,558
Australia.....	2,257	357	9,851
Europe (a).....	12,500	12,300	121,700
Belgian Congo..	14,109	13,999	124,670
Elsewhere (b)...	3,000	3,000	30,000
Total.....	174,553	178,269	1,804,158

(a) Incomplete, partly estimated. (b) Estimated.

Total output of copper for the first ten months of the year was 1,804,158 tons, which compares with 1,553,418 tons in the similar period last year, and 1,397,410 tons in the same time in 1927.

World Lead Production in October 169,501 Tons

THE world production of lead in October was 169,501 tons, against 159,018 tons in September and 153,046 tons in October of last year. Output for the ten months ended with Oct. 31 totaled 1,606,998 tons, which compares with 1,494,005 tons for the similar period in 1928, according to the American Bureau of Metal Statistics.

World production, in tons, for September, October, and the January-October period, is given in the following table:

	Sept.	Oct.	Jan.-Oct.
United States (a).....	56,807	61,491	576,871
Canada (a).....	13,878	14,584	132,042
Mexico (a).....	20,983	23,319	231,949
Total North America (a)	91,668	99,394	940,862
Peru.....	1,586	1,213	16,784
Germany.....	11,881	11,834	98,553
Italy.....	1,625	(d) 2,000	18,990
Poland (b).....	3,387	3,175	30,829
Spain and Tunis (c)...	8,035	8,603	97,142
Australia.....	16,442	18,610	160,491
Burma.....	7,394	7,672	74,516
Rhodesia.....	.....	.....	1,831
Elsewhere, estimated..	17,000	17,000	167,000
World's total.....	159,018	169,501	1,606,998

(a) North American production is correctly stated, but the distribution by countries is not precise. (b) Represents production of Polish Silesia. (c) Partial. (d) Partly estimated.

Gold Output in Ontario Up

Gold production of Ontario for October shows that 346,691 tons were treated, the recovery being $3,071,591, an average of $8.85 per ton. This is the second highest month on record, being exceeded only by December, 1927, when the output was $3,400,000. The remainder of the year, however, is likely to show a decrease because of the fire which destroyed the Dome mill. Of the total output, the Porcupine camp produced $1,921,922, from 249,108 tons of ore, an average of $7.72. The Kirkland Lake mines treated 97,533 tons in October and recovered $1,148,728, an average of $11.80 per ton.

U. S. Silver Production in October Shows Gain

PRODUCTION of silver in the United States in October totaled 5,053,000 oz., against 4,634,000 oz. in September, and 4,352,000 oz. in October, 1928. Production in Canada during October was 2,705,000 oz., comparing with 2,437,000 oz. in the preceding month, and 2,051,000 oz. in October last year, according to the American Bureau of Metal Statistics. Peru produced 1,556,000 oz. of silver in October, against 1,846,000 oz. in the corresponding month last year. Australia is credited with an output of 854,000 oz. for October, against 628,000 oz. in the same month last year.

World production of silver in August amounted to 20,612,000 oz., against a total of 22,612,000 in July and 19,458,000 oz. in August of last year. August is the latest month for which world production figures for silver are available.

Silver Producers Merge

Shareholders of Capitol Silver and Castle-Trethewey mining companies, operating in the Gowganda area of Ontario, have ratified plans for the amalgamation of the two properties. Castle-Trethewey will increase its capitalization from 2,000,000 shares, now authorized and outstanding, to 3,000,000 shares. Capitol will receive 709,002 shares, which will be distributed to the stockholders at the rate of one share for each five shares now held. The merger gives the combined companies quick assets in excess of $900,000.

PATIÑO MINES AND ENTERPRISES CONSOLIDATED, INC., reports net profit for the nine months ended Sept. 30 of $3,840,779, after depreciation, depletion, interest, and other charges, equivalent to $2.78 a share, against $3,595,455, or $2.60 a share, in the corresponding period last year.

THE FEDERATED MALAY STATES has under consideration a program for conserving its tin resources. Authorities in London expect that action by the Malayan government will accelerate the movement for rationalization, including regulation of output and co-operative selling of tin.

NICKEL EXPORTS FROM CANADA during the first ten months of 1929 amounted to 92,221,800 lb., valued at $21,550,000. This is an increase of 12,400,000 lb. and $3,867,000 in value over the corresponding period last year. The increase in value relative to the quantity is explained by the gradual extension of the nickel refining facilities at Port Colborne.

London Financial News

W. A. DOMAN
Special London Correspondent

LONDON, Nov. 12, 1929.—As prices for Rhodesian copper and the tin shares are falling, the question naturally arises: what is the reason? Despite the fact that American interests are reported to have very substantial holdings in the copper ventures, and that these interests are not likely to sell, there can be only two explanations of the relative weakness at present existing. One is that no further stimulus is forthcoming and the other that certain people on this side are selling. When this is discovered, it is obvious that paper prices, which discount the future to so great an extent, are being converted into profits, with the probability of replacing holdings at a later date. Human nature being what it is, good points are trotted out when prices are rising, and faults are found when they are falling.

This much is clear—a group of persons in London, who disbelieve the amazing reports of tonnages, recovery, and profits, dispatched a reputable engineer to investigate on the spot. He has returned, and for the next three years, at least, is bearish so far as price movements are concerned. The ground in several places, he says, is not easy working, and the capital expenditure will be enormous. At the Gold Fields Rhodesian Development Corporation meeting, Lord Harris, the chairman, when asked why the company did not interest itself more in copper propositions, made the remark that shareholders were in the habit of looking for regular dividends from gold-mining undertakings, and there was no prospect of a return from money locked up in copper for a long time to come. It is not surprising, therefore, that apart from the "big men" who are taking profits, holders of small numbers of shares are beginning to sell.

With tin the case is different. Earlier in the year, when I mentioned that stocks of tin were being carried in this country, the statement was denied. It is still true, however, that a good deal of the metal is held in warehouses here, and, it is said, by people who are becoming both tired and nervous, seeing that operations began at about £220 per ton, and that the price today is £176 8s. 9d. per ton. Though tin producers desire to restrict production of the metal, the F.M.S. Government is not favorable to the scheme.

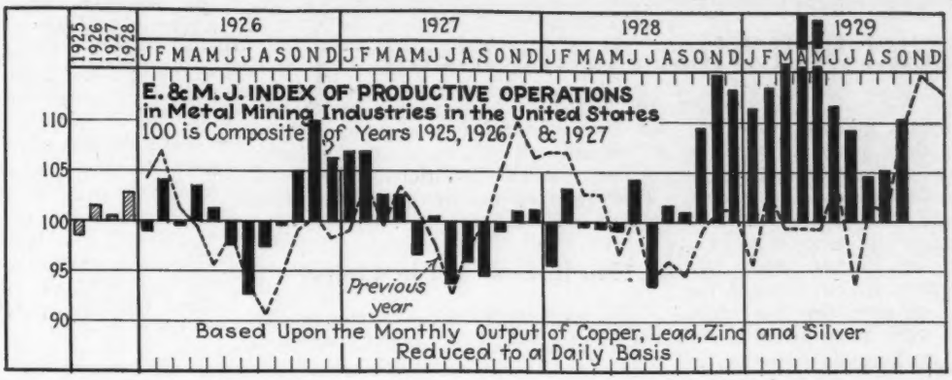
Much interest is being taken in a development at Mysore mine, in India. A pilot shaft has been sunk some 1,600 ft. east of the main workings, on ground formerly held by companies that failed to achieve success. At a depth of 280 ft. the reef assays 3 oz. 8 dwt. gold over a width of 21 in. Too much can, of course, be made of this discovery.

A gold find is reported in Salonika, near Katerina, and the discovery of platiniferous beds is also mentioned.

A ministerial decree in Spain announces the immediate suspension of all mining concessions that contain tin.

Indicators of Industrial Activity

of Significance to Mining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E. & M. J. INDEX OF PRODUCTIVE OPERATIONS
in Metal Mining Industries in the United States
100 is Composite of Years 1925, 1926 & 1927
110
105
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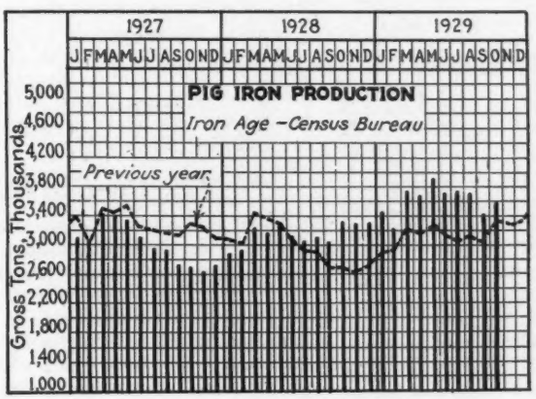
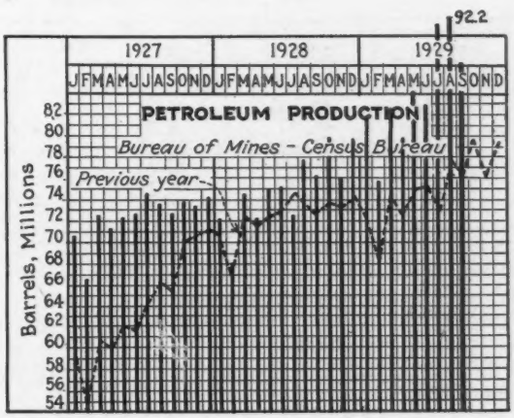
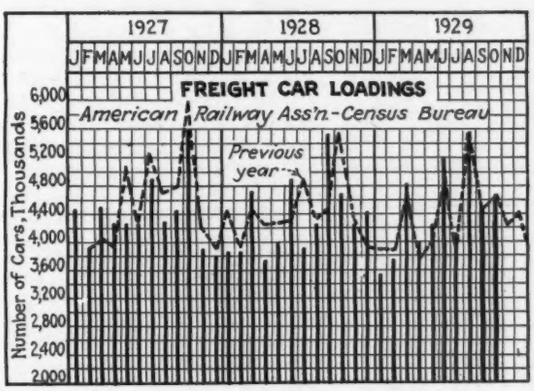
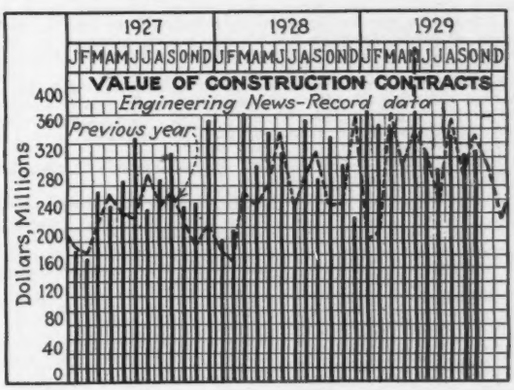
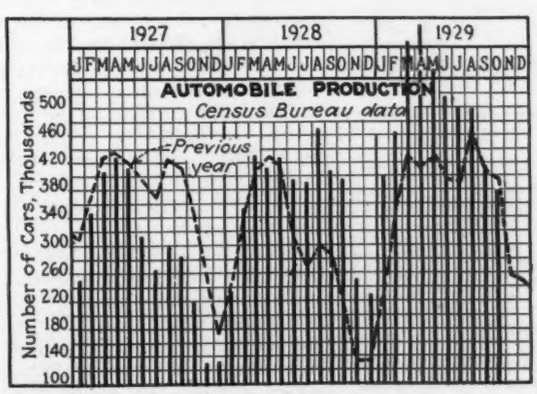
95
90
Previous year
Based Upon the Monthly Output of Copper, Lead, Zinc and Silver
Reduced to a Daily Basis

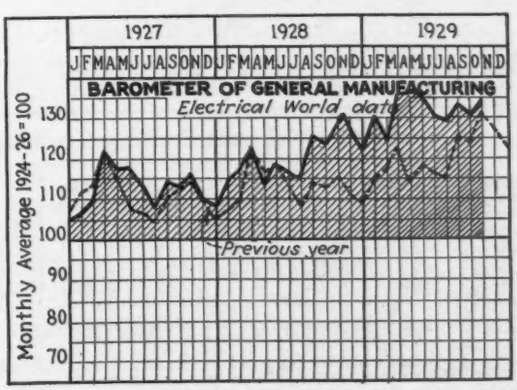












The Market Report

Lead Still Most Active Metal

New York, Nov. 27, 1929.—The non-ferrous metal markets are substantially unchanged from last week so far as the total volume of business is concerned; sales of lead were somewhat reduced, whereas zinc orders increased. The improvement in zinc sales was brought about by further price concessions yesterday, which brought the price down to an even 6c., St. Louis. Copper and tin were quiet, prices of the former being unchanged, whereas tin has been higher, reaching close to 42c. on Monday, though down today. Silver is virtually unchanged, as are the minor metals, though conditions may be a shade weaker in the quicksilver and platinum markets.

No Interest Yet in Copper

The last three weeks have set a record for quiet business in copper, domestic demand averaging only about a couple hundred tons a day. Nevertheless, prices are as firm as ever, and it is even said that less copper is now available from second-hands at price concessions than there was a week or two ago. What little demand existed has been for prompt shipment. It is generally believed that the copper bought three months ago and later will be sufficient to carry consumers pretty well through to the end of the year at the reduced rate of operation that many of them have recently adopted. A special effort will probably be made to have inventories at the end of the year as small as possible. For January use, however, it is almost certain that a good tonnage of copper must be bought, for only 30 per cent of normal monthly requirements have so far been booked for shipment that month. A respectable buying movement may therefore be expected during the holidays or before, and there is every indication that the price will not be below the current level of the producers.

Export business in the last week has improved somewhat, and further immediate improvement, for prompt shipment, is expected. Total sales for November are not likely to be greater than for October, however.

Daily Prices of Metals

Nov.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
21	17.775	41.125	6.25	6.10	6.20@6.25
22	17.775	41.50	6.25	6.10	6.15@6.25
23	17.775	41.625	6.25	6.10	6.15@6.25
25	17.775	41.875	6.25	6.10	6.15@6.25
26	17.775	41.75	6.25	6.10	6.025
27	17.775	41.50	6.25	6.10	6.00
	17.775	41.396	6.250	6.100	6.14

Average prices for calendar week ending November 23, 1929, are: Copper, 17.775c.; Straits tin, 40.708c.; New York lead, 6.250c.; St. Louis lead, 6.100c.; zinc, 6.221c.; and silver, 49.813c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East are 1@1.15c., depending upon purity, above St. Louis prices for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Nov.	Copper		Electrolytic	Tin		Lead		Zinc	
	Standard								
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
21	69 7/8	69 3/8	81 1/2	184	186 1/2	20 7/8	21 1/8	20 1/16	20 1/2
22	71 1/2	70 3/4	82 3/4	186	188 1/2	21 7/16	21 1/2	20 1/8	20 9/16
25	71 3/4	70 7/8	83	190 1/8	192 3/8	21 7/16	21 1/2	20 1/8	20 1/4
26	71 1/4	70 1/4	83	188 1/2	191 1/4	21 5/16	21 3/8	20 1/16	20 3/8
27	69	68	83	184 3/4	187 3/4	21 3/8	21 3/8	20 1/8	20 1/8

Prices for lead and zinc are the official closing prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
21	$4.87	49 7/8	22 3/4	84s 10 3/4d	25	$4.87 3/16	49 1/8	22 11/16	84s 11 1/4d
22	4.86 15/16	49 7/8	22 11/16	84s 11 1/4d	26	4.87 3/16	49 1/8	22 11/16	84s 11 3/4d
23	4.87 1/16	49 3/4	22 3/4	.....	27	4.87 1/4	49 1/4	22 9/16	84s 11 1/2d

Average: Silver, 49.667c.; Sterling Exchange, $4.8710

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-eighths cent premium.

Zinc Down to 6c.

Some zinc was booked as late as Monday for 6¼c., St. Louis, though 6.15 and 6.20c. were more usual prices for the small quantities sold. Yesterday, a more determined effort was made to get business, and after meeting with only fair success at 6.10 and 6.05c., several producers sold substantial tonnages at an even 6c. Specifications as to shipment varied from spot to January. Today, the 6c. price is general, though the demand has been disappointing. High-grade zinc has recently been as dull as Prime Western, and the greater production of this grade does not make the problem of its marketing at the customary premium a simple one.

Steady Call for Lead

Demand for lead continues at a good rate, though the last week was not quite so active as the preceding seven-day period. Prices were firm, but quotably unchanged at 6.25c., New York, the contract price of the American Smelting & Refining Company, and 6.10c., St. Louis. London reported a fairly steady market and prices there held above the New York basis throughout the week. The sales in the domestic market amounted to an average week's business, with most of the large consuming interests represented on the buying end. Demand for lead from cable manufacturers, corroders, battery manufacturers, and ammunition makers is holding up well for this time of the year.

Most of the business was for November and December shipment. Inquiry for January lead increased as the week progressed, and about 20 per cent of the tonnage sold in the period was for shipment in that month. Not all sellers were anxious to quote on January business, however.

From present indications the sales for November will be somewhat greater in volume than in October, which is regarded as a most favorable showing in view of the general unsettlement in business. The low prices naturally attracted all classes of consumers, many of whom expressed confidence in the situation by placing a good tonnage for shipment two months hence. With production curtailed, producers feel that the market is in a sound position.

Tin Quiet

Early in the week the market for tin exhibited a firmer tone, inspired by higher prices in London, where support by the bullish element injected some life into the trade. Evidently much was expected of the outcome of the meeting of the Tin Producers' Association held in London to take action in the matter of restricting production. Word from London received here today indicated that the group, representing about 20 per cent of the world's production of tin, proposed a plan offering a bonus to be paid to the smelters for curtailing their output 10 per cent. Traders here believe that such action will not be sufficient to bring about a change in the general situation, and as a result business in tin showed no improvement. At the close the market was rather easy, though higher than a week ago.

Silver Lower and Inactive

Owing to the unsettled condition in China and the consequent weakness in China exchanges, the silver market has been inactive, resulting in a further decline in prices. The tendency is uncertain.

Mexican Dollars (old Mexican pesos): Nov. 21st and 22d, 37c.; 23d, 36⅞c.; 25th and 26th, 36¾c.; 27th, 36½c.

Foreign Exchange

Closing cable quotations on the principal Continental exchanges on Tuesday, Nov. 26, were as follows: Francs, 3.93⅞c.; lire, 5.235c.; and marks, 23.935c. Canadian dollars, 1⅛ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8⅞c. per lb. for spot and 8½c. per lb. future shipments. Some good buying of spot and near-by and price holding steady. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.80 and up.

CADMIUM — Per lb., New York: 80@90c. Inside price named on contract business.

IRIDIUM — Per oz., $220@$230 for 98@99 per cent sponge and powder.

NICKEL — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $35@$37. Small lots bring up to $46.

PLATINUM — Official price quoted by the leading interest on small orders for refined metal is $65 per oz. Transactions between dealers and refineries in the outside market are reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $122@$123.50. Demand quiet. Imports for the first nine months of 1929 totaled 654,478 lb., against 762,848 lb. in same time last year. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of Nov. 9.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.25@$15.35 for future shipment. Prices holding about steady on moderate offerings from primary centers. Trading continues quiet. Bolivian scheelite, $15.25, Dec.-Jan. shipment. Western scheelite, $16.50 for Jan. shipment.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the Nov. 9 issue.

Platteville Slightly Lower

Platteville, Wis., Nov. 23, 1929

Zinc Blende	Per Ton
Blende, basis 60% zinc	$42.50
Lead Ore	
Lead, basis 80%	$75.00

Shipments for the week: Blende, 568 tons; lead, 40 tons. Shipments for the year: Blende, 30,224; lead, 1,935 tons. Shipments for the week to separating plants, 1,361 tons blende.

Tri-State Dull

Joplin, Mo., Nov. 23, 1929

Blende	Per Ton
High	$42.05
Premium blende, basis 60%..	40.00
Prime Western, basis 60%..	$39.00@ 40.00
Table concentrate, basis 60%	38.00@ 39.00
Flotation concentrate 60%.	36.00@ 37.00
Average settling price, all...	39.28
Galena	
High	$78.40
Basis 80% lead	75.00
Average settling price, all..	76.98

Shipments for the week: Blende, 7,593; Galena, 1,541 tons. Value, all the week, $416,920.

Prices are unchanged. Production of zinc concentrates has dropped to 64 per cent of normal, and further restriction is indicated.

The average settling price for a ton of zinc concentrate is about $3 below recent average production costs for zinc-lead concentrate.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Nov. 9 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Fair demand and price is steady.

SODIUM NITRATE — Per 100 lb., $2.12 for prompt delivery.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Nov. 9 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace on carload business.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45 f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the Nov. 9 issue.

Rolled Metals

Copper, zinc, Monel metal, nickel sheets, and copper wire are unchanged from prices in the Nov. 9 issue. Lead sheets, full rolled, 10¼c.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Nov. 9.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL — Base prices per gross ton, Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.90@$1.95.

COKE — Per gross ton, Connellsville furnace, $2.65@$2.75. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended November 23, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	86⅛	79⅜	80⅜	Oc. 11 No. 18 Q	1.75
Andes Copper	New York	38½	35½	36⅛	Oc. 11 No. 11 Q	0.75
Arizona Com	Boston	1½	1⅜	1½	Jl. 16 Jl. 31 SA	0.25
Calumet & Ariz	New York	97½	90	92	De. 6 De. 23 Q	2.50
Calumet & Hecla	New York	40	32	37⅛	No. 30 De. 31 Q	1.50
Cerro de Pasco	New York	70⅛	67	67	Oc. 10 No. 1 Q	1.50
Con. Coppermines	N. Y. Curb	6⅞	6¼	6⅜		
Copper Range	Boston	17⅜	16¾	17⅜	Se. 14 Oc. 15 Q	0.50
East Butte	Boston	2⅜	2	2	No. 20, De. 21	0.25
Granby Con	New York	60	53	58	Oc. 18 No. 1 Q	2.00
Greene Cananea	New York	115	115	115	Se. 12 Oc. 7 Q	2.00
Howe Sound	New York	42	38	40⅛	Se. 30 Oc. 15 Q	1.00
Hudson Bay	N. Y. Curb	11⅛	9	11		
Inspiration	New York	32⅞	30⅛	31⅜	Se. 9 Oc. 7 Q	1.00
Isle Royale	Boston	17⅛	15⅞	16⅛	No. 30, De. 31 Q	0.50
Kennecott	New York	67⅛	62⅜	62⅜	No. 29, Ja. 2 Q	1.25
Magma Copper	New York	52⅛	48⅛	50	Se. 30, Oc. 15 Q	1.25
Mason Valley	N. Y. Curb	2	2	2		
Miami Copper	New York	33	30	30	No. 1, No. 15 Q	1.00
Mohawk	Boston	48	46	46	Oc. 3, De. 2	3.00
Mother Lode	New York	2	1⅜	2	Je. 13, Je. 29	0.20
Nevada Con	New York	33⅜	31⅛	32	Se. 18, Se. 30 Q	0.75
Noranda	N. Y. Curb	37	33⅛	36	De. 10, Ja. 2 Q	0.75
Ohio Copper	N. Y. Curb	1⅛	1	1⅛	Sept., 1926	0.03
New Dominion	Boston	7	6	6⅝	Dec., 1918	1.00
Phelps Dodge	New York	45⅜	40	43⅛	De. 6, Ja. 2 Q	0.75
Quincy	Boston	21⅛	19	21⅛	March, 1920	1.00
Roan Antelope	N. Y. Curb	33	28⅞	30⅛		
St. Mary's M. L.	Boston	28⅛	24⅛	27⅛	No. 29, De. 10	1.00
Seneca Copper	New York	3⅛	2⅞	3		
Shattuck Denn	N. Y. Curb	9⅛	8⅛	9⅛		
Sheritt-Gordon	Toronto	4.15	3.50	3.75		
Tenn. C. & C.	New York	13	11⅞	12⅛	No. 30, De. 16 Q	0.25
United Verde Ex.	N. Y. Curb	13⅛	12⅛	13⅛	Oc. 2, No. 1 Q	1.00
Utah Copper	New York			325	Se. 18, Se. 30 Q	4.00
Waite-Ack.-Mont.	Toronto	3.75	3.25	3.75		
Walker Mining	Salt Lake	4.40	4.20	4.25		
Wenden Copper	N. Y. Curb	*75	*75	*75		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	1.00	*87½	*87½		
Amer. Z. L. & S.	New York	12½	10	11⅛	May, 1917	1.00
A. Z. L. & S., pfd.	New York	61	54½	60	De. 12, Ja. 1 Q	1.50
Bunker Hill & S.	N. Y. Curb	105	105	105	Oc. 24, No. 5 X	0.75
Butte Cop. & Zn.	New York	4⅛	4	4	De. 10, De. 25	0.50
Butte Cop. Con.	Boston Curb			*31½		
Butte & Sup.	New York	6⅛	6	6⅛	Je. 14, Je. 29 Q	0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	2.30	2.17½	2.20	Fe. 1, 1918 K	0.10
Consol Ld. & Zn. "A"	St. Louis	9	8	8	Se. 20, Oc. 1 Q	0.25
Constitution	Spokane	*37½	*36	*36		
Dayrook	Spokane	2.00	1.50	1.90	Je. 20, Je. 30	0.03
Dickens Consol.	Spokane	*5⅛	*4½	*4⅛		
Eagle-Picher	Cincinnati	14	13	13½	Se. 30, Oc. 15 Q	0.20
Eagle-Pich., pfd.	Cincinnati			101	Se. 30, Oc. 15 Q	1.50
Erupcion	Boston Curb			*12	Jan. 1, 1928	0.07½
Eureka Bullion	Salt Lake	*65	*59	*60		
Evans-Wallower	N. Y. Curb	6⅞	4	6		
Evans-Wal., pfd.	N. Y. Curb			10⅛	Je. 20, Jl. 1 Q	1.75
Federal M. & S.	New York			200	June, 1927	10.00
Fed. M. & S., pfd.	New York	98½	98½	98½	No. 25, De. 16 Q	1.75
Gladstone	Spokane	*2⅛	*2	*2		
Golconda	Spokane	*83	*77	*80	Je. 15, Jl. 1	0.02
Grandview	Spokane	*23½	*22⅜	*23½		
Hecla Mining	N. Y. Curb	14⅜	13⅜	14	No. 15, De. 15 Q	0.25
Highland-Surprise	Spokane	*9¼	*7½	*8		
Jack Waite	Spokane	*11	*8⅛	*8⅛		
Kootenay Florence	Spokane	*8	*7¼	*8		
Lucky Jim	Spokane	*7	*6	*6		
Lucky Tiger-C.	Kansas City		†2.25		No. 9, No. 20 M	0.02½
Mexican Premier	Spokane	1.87	1.82	1.85		
National Lead	New York	150	136	150	De. 13, De. 31 Q	1.25
Natl. Lead, pfd. A	New York	139	138	139	Nv. 29, De. 14 Q	1.75
Natl. Lead, pfd. B	New York	116	116	116	Jc. 17, Fe. 1 Q	1.50
N. J. Zinc, new	N. Y. Curb	70	67	70	No. 20, De. 10 X	0.50
New Quincy	Salt Lake	1.40	1.17½	1.17½	Se. 20, Se. 30 Q	0.10
Noble Five	Spokane	*42½	*40	*40		
North Lily	Salt Lake	4.45	4.40	4.40	Oc. 16, Oc. 23	0.25
Park Bingham	Salt Lake	*7½	*6½	*7½		
Park City Con.	Salt Lake	1.00	1.00	1.00		
Park Utah	New York	4⅛	3⅞	3⅞	Dividends suspended	
Pend Oreille	Spokane	3.00	2.75	2.75		
Rico Argentine	Salt Lake	*20	*19	*19	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*22½	*18	*20		
St. Joseph Lead	New York	53	49	50	Se. 10, Se. 20 QX	0.75
Sherman Lead	Spokane	*50½	*45	*45		
Silver King Con.	Salt Lake	10.25	10.22½	10.25	Se. 20, Oc. 1 Q	0.25
Silversmith	Spokane	*7	*6⅜	*6⅜	Oct., 1926	0.02
Sunshine Mining	Spokane	5.90	5.25	5.25	Se. 10, Se. 20 Q	0.05
Tamarack-Custer	Spokane	*48	*44	*44	Sept., 1924	0.25
Tintic Standard	Salt Lake	10.52½	10.50	10.50	Se. 17, Se. 20 X	0.30
Tonopah Belmont	N. Y. Curb			*37½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	7.50	7.45	7.50		
United Zinc Smg, New	N. Y. Curb	7	7	7		
Utah Apex	Boston	3⅛	3	3⅛	Oc. 15, No. 1	0.25
Utah Met. & Tun.	Boston	*90	*65	*80	Dec., 1927	0.30
Whitewater	Spokane	*25	*22	*23		
Yellow Pine	Los Angeles			*8	Dec., 1925	0.04
GOLD						
Alaska Juneau	New York	6⅜	5⅜	6⅜		
Barry-Hollinger	Toronto	*20½	*16	*18		
Central Manitoba	Toronto	*27	*21	*24½		
Creson Consol.	N. Y. Curb	*43¾	*37½	*43¾	Se. 30, Oc. 10 Q	0.02
Dome Mines	New York	7	6⅜	7	De. 31, Ja. 20 Q	0.25
Golden Cycle	Col. Springs	†16.00	†15.25		Au. 31, Se. 10 Q	0.04
Hollinger	Toronto	5.20	4.90	5.10	No. 15, De. 2 FW	0.05
Homestake	New York	80	74	80	No. 20, No. 25 M	0.50
Kirkland Lake	Toronto	*60	*55	*60		
Lake Shore	Toronto	20.00	18.00	20.00	De. 2, De. 16 Q	0.30
McIntyre Porcupine	New York	14	13	14	Nv. 1, De. 2 Q	0.25
Portland	Col. Springs	†*8	†*6½		April, 1927	0.01
Rand Mines	New York			25	Au. 21, 29 A.s.	1.50
Siscoe	Toronto	**63	*56	*60		
Sylvanite	Toronto	*50	*45	*45		
Teck-Hughes	Toronto	5.30	5.05	5.15	Oc. 18, No. 1	0.15
Tom Reed	Los Angeles	*60	*30	*30	Dec., 1926	0.02
Unity Gold	N. Y. Curb	*87½	*50	*75		
Vipond Consol.	Toronto	**62	*60	*62	April, 1927	0.03
Wright-Hargreaves	Toronto	1.34	1.22	1.31	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35½		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	7	6½	6½		
Castle-Trethewey	Toronto	*30	*28	*30		
Consol. Cortez	N. Y. Curb			*6½		
Dolores Esperanza	N. Y. Curb	*25	*18½	*25	July, 1923	0.05
Keeley	Toronto	*38	*36	*38	Mr. 15, 1928	0.04
Mining Corp.	Toronto	3.39	3.05	3.35	De. 4, De. 19	0.12½
Montana-Mines Corp.	Spokane	*40	*37½	*38		
N. Y. & Hond. Ros.	N. Y. Curb	14	14	14	Oc. 16, Oc. 26 QX	0.50
Nipissing	N. Y. Curb	1⅞	1⅞	1⅞	De. 31, Ja. 20 Q	0.07½
Premier Gold	N. Y. Curb	1⅛	1⅛	1⅛	Se. 12, Oc. 3 Q	0.06
Tonopah Exten.	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb			2	Se. 30, Oc. 21	0.07½
United Eastern	N. Y. Curb	*18⅛	*18⅛	*18⅛		
Yukon Gold	N. Y. Curb			*56½	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	93⅛	85	91	Jan. 18, Fe. 15 Q	1.50
Beth. Steel, pfd, 7%.	New York	123	118½	122	De. 7, Ja. 2 Q	1.75
Cleveland-Cliffs	Cleveland	97	94⅛	94⅞	Se. 5, Se. 15 Q	1.00
Colo. Fuel & Iron	New York	35⅜	31½	34		
Colo. F. & I., 1st pfd.	New York			127	No. 10, No. 1 Q	2.00
Great Northern Iron	New York	25	23½	24½	Dec. 15 K	2.00
Inland Steel	New York	78	77	77	No. 15, De. 1 Q	0.87½
Republic I. & S.	New York	78⅛	78⅛	78⅛	No. 12, De. 2 Q	1.00
Republic I. & S. pfd.	New York	105	104	104	De. 12, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	32	27½	32	Mr. 11, Mr. 20 Q	1.50
Sloss-Sheff. S. & I., pfd.	New York	65	65	65	Se. 20, Oc. 1 Q	1.50
U. S. Steel	New York	171⅛	159⅜	167	No. 30, De. 30 QX	2.75
U. S. Steel, pfd.	New York	140	138	140½	No. 2, No. 29 Q	1.75
Virginia I. C. & C.	New York			15⅜	Jan., 1924	1.50
Virginia I.C.&C., pfd.	New York	40	40	40	Jl. 16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	270	220	260		
Alum. Co. of Amer., pf.	N. Y. Curb	107½	104	107½	Mr. 15, Ap. 1 Q	1.50
American Metal	New York	46½	43⅛	45	No. 20, De. 2 Q	0.75
Amer. Metal, pfd., 6%	New York	111⅞	108	111⅞	No. 20, De. 2 Q	1.50
Amer. Sm. & Ref.	New York	78	72⅛	76⅛	Oc. 11, No. 1 Q	1.00
Amer. Sm. & Ref., pfd.	New York	135⅛	124⅛	135⅛	No. 1, De. 2 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	23	19⅛	23		
Asbestos Corp.	Montreal	3⅛	3⅛	3⅛	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	14	12	12	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	276	255	276	Je. 29, Jl. 15 SA	X6.25
De Beers Consol.	New York			21	Jl. 23, Jl. 26 Q	0.96
Federated Metals	N. Y. Curb	25	23½	25	Oc. 3, Oc. 11 Q	0.25
Freeport Texas	New York	36⅜	30⅛	36	Oc. 15, No. 1 Q	1.00
Int. Nickel Can.	New York	32⅛	29⅛	31⅛	No. 30, De. 31 Q	0.25
Int. Nickel, pfd.	New York			112	Se. 28, No. 1 Q	1.75
Mayflower Assoc.	N. Y. Curb	51	46⅛	49		
Metal & Mining	N. Y. Curb	10⅜	8⅛	10⅛	Se. 21, Oc. 1	0.30
Newmont	N. Y. Curb	134½	125	131⅛	Se. 30, Oc. 15 Q	1.00
Patino M. & E.	New York	31⅞	28⅛	31⅛	Au. 31, Se. 28 A.s.	0.97
So. America G. & P.	N. Y. Curb	1⅛	1⅛	1⅛		
Texas Gulf Sulphur	New York	58⅛	53⅛	57⅞	De. 2, De. 16 Q	1.00
U. S. Sm. R. & M.	New York	39½	36	39	Oc. 7, Oc. 15 Q	0.87½
U. S. Sm. R. & M., pfd	New York	51	50	50	Oc. 7, Oc. 15 Q	0.87½
Vanadium Corp.	New York	55⅛	48⅛	53⅛	Nv. 1, De. 16 QX	1.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I Initial. R, Respumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. A.s., American shares.

LONDON QUOTATIONS—WEEK ENDED November 12, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	12/6	12/6	12/6		
Alaska Treadwell ($25)	66/3	66/3	66/3	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	48/9	48/9	48/9	Nov., 1929	5 p.c.
Burma Corpn. (10 rupees)	17/8	16/4½	16/7½	July, 1929	9 annas*
Bwana M'Kubwa (5s)	26/4½	21/9	22/—		
Camp Bird (2s)	1/10½	1/6	1/9	April, 1928	16½ p.c.
El Oro (5s)	3/9	3/4½	3/6	Nov., 1929	20⅝ p.c.*
Frontino & Bolivia (£1)	6/10½	6/10½	6/10½	Jan., 1929	3½ p.c.
Mexican Corpn. (£1)	13/3	12/7½	12/9	Oct., 1929	10 p.c.
Mexico Mines of El Oro (£1)	1/9	1/9	1/9	Dec., 1926	3½ p.c.*
Mount Isa (£1)	30/—	25/7½	30/—		
N'Changa Copper Mining (£1)	43/1½	35/—	35/—		
Oroville Dredging (4s)	1/6	1/6	1/6	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	170/—	145/—	145/—		
St. John del Rey (£1)	17/—	16/4½	16/9	Dec., 1929	2½ p.c.
San Francisco Mines (10s)	34/9	29/3	30/—	June, 1929	15 p.c.
Santa Gertrudis (£1)	12/3	10/6	11/—	July, 1929	7½ p.c.
Selukwe (2s. 6d.)	5/3	4/6	4/6	April, 1917	6¼ p.c.
S. Amer. Copper (2s)	2/3	1/9	2/—	Nov., 1917	75 p.c.
Tanganyika (£1)	48/9	40/—	40/—	July, 1929	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	9,935	9,025	9,025	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation.